SAE JOURNAL

PRODUCTION TOMORROW ISSUE

IN THIS ISSUE . . .

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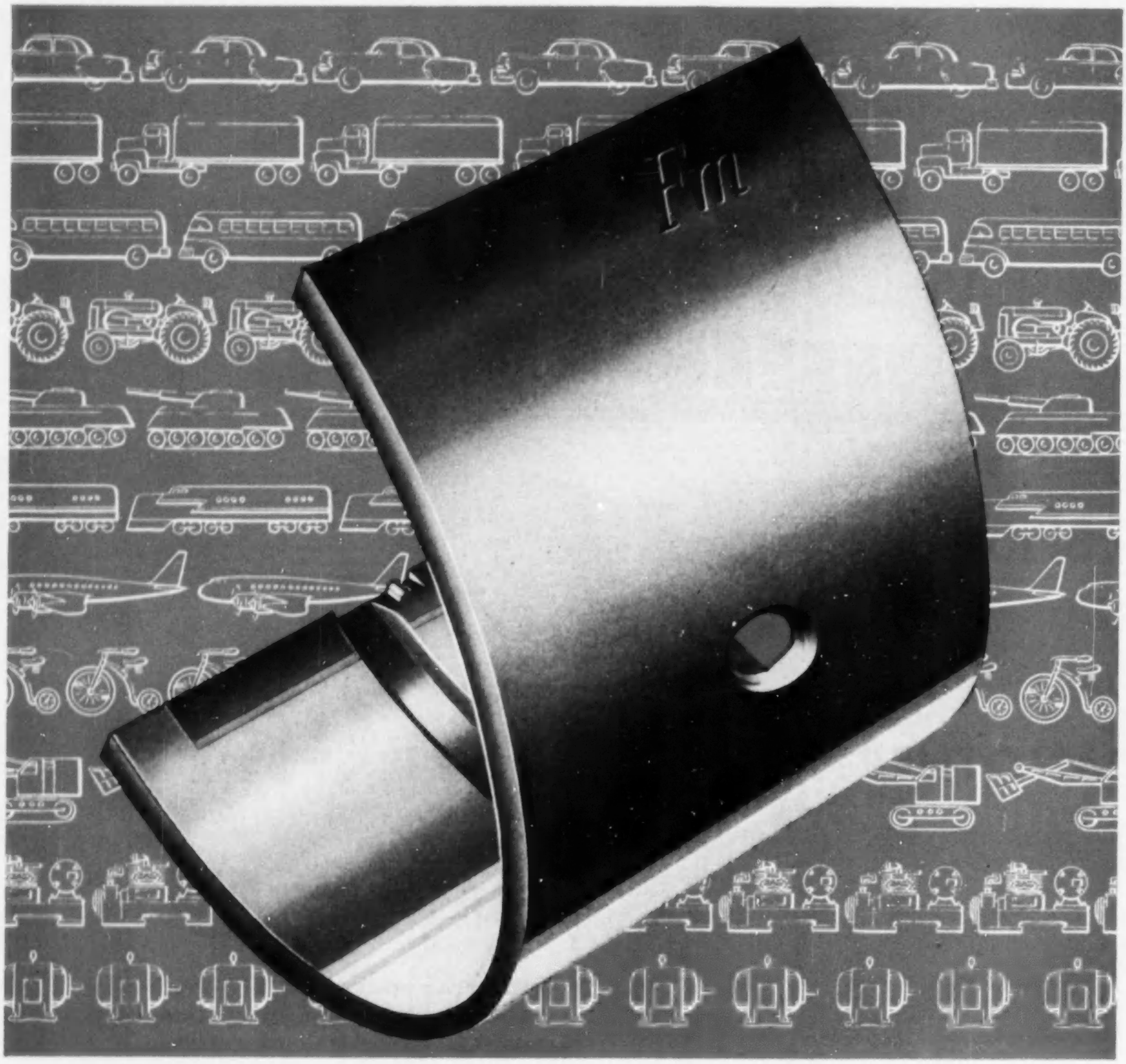
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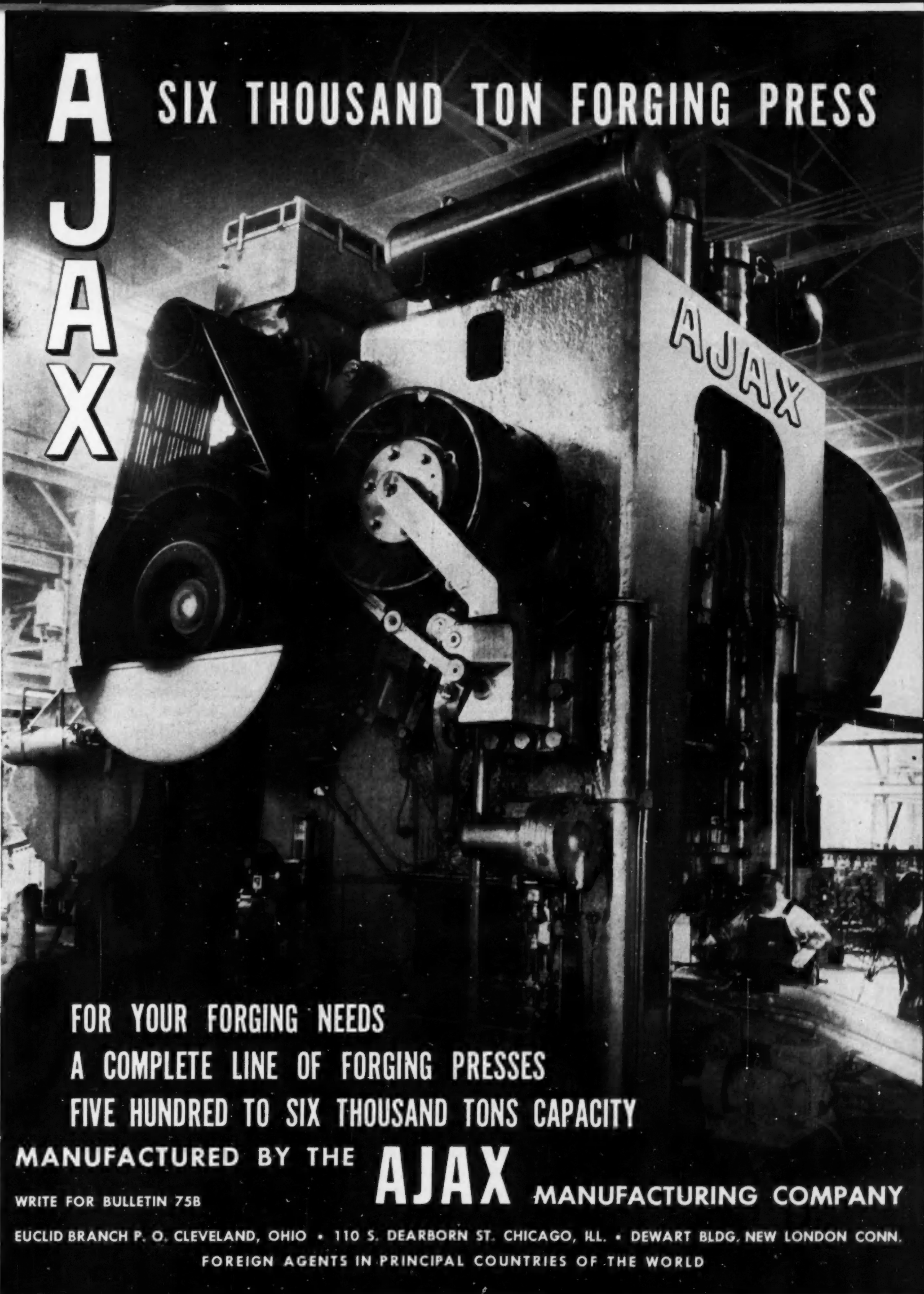
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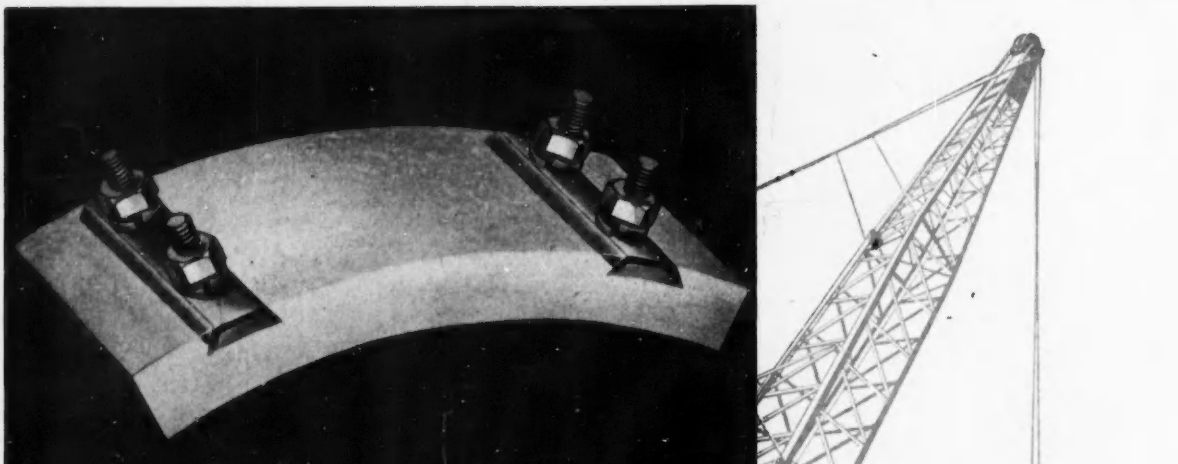

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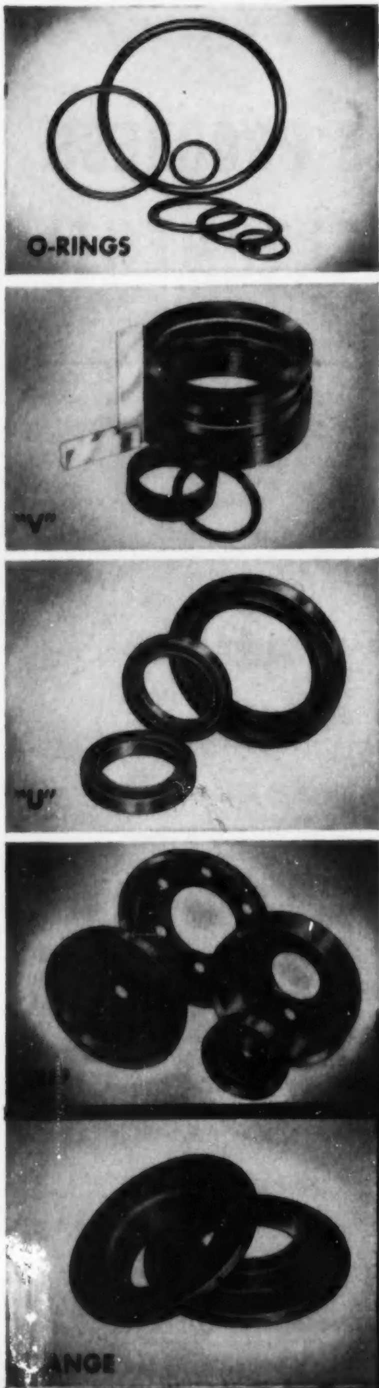

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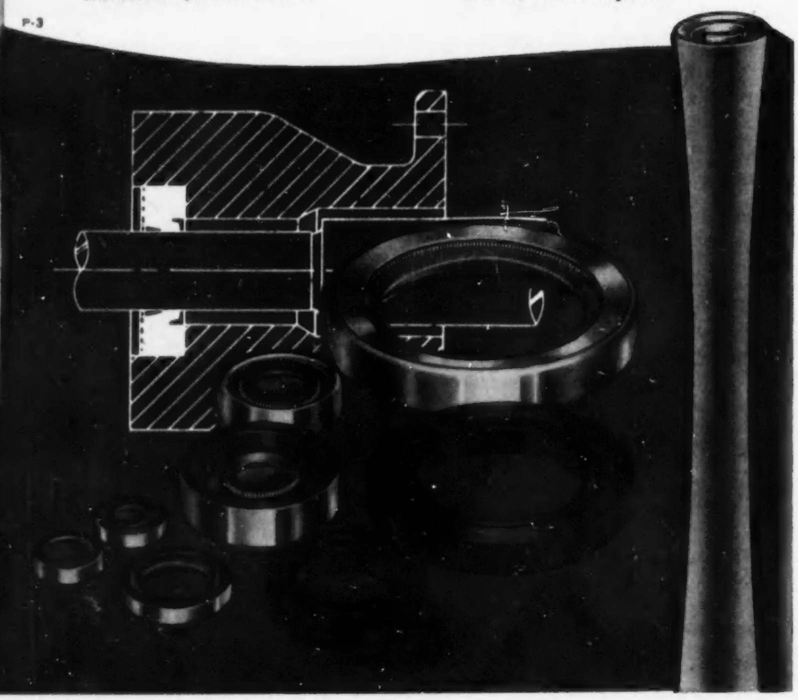

For the Sake of Argument

What and How—Rather than Where and When . . .

By Norman G. Shidle

Time and experience are not synonymous.

Experience is recorded in a person's consciousness. Some people record much useful experience in a very short time; others record more slowly. Some seem scarcely to record at all.

Yet, "What is your experience?" is a common gambit in the average employment interview. Response is usually in terms of where the applicant has worked and what his duties were. The interviewer learns nothing of what the applicant has accomplished—or how.

Twenty-five applicants for a job as editor of a technical handbook recently gave the propective employer a list of previous jobs held and the dates of exposure on each. They told him, in effect, the areas in which they had been supposed to be accomplishing something for some years past. They gave no hint of what, if anything, they actually had accomplished.

Only one made the slightest pass at giving any such all-important information. In addition to the usual listing of areas covered, including writing of technical manuals, she wrote:

> "In the course of preparing manuals, I was able to devise a time and money-saving system. This system makes it possible to use parts of a master copy many times, from book to book, and yet to be able to reassemble the master copy of any book for reprinting."

Not much, to be sure . . . but it was the only specific story of a specific achievement in 25 letters of application. Enough, it was, to get her the interview. The interview developed more specific stories of specific accomplishment. She got the job.

The story of methods and results is the only meaningful record of experience which an applicant has actually made his own. Experience which has become a part of a man's consciousness—of his very being—is the experience that points to what he will do and how he will do it.

The important thing is not how long he has been exposed to business or professional life, but what kind of a person the exposure has made of him.

Regardless of exposure-time, a man can use intelligence, integrity, originality, capacity, and industry on almost any job. So, suppose he has exhibited these qualities in his experience. Then the simple, factual story of what *he* did about problems faced—and what results *he* got—will record them, as nothing else will.

If he has and exercises the qualities needed for a particular job, the time he has spent developing them will matter little. . . . The pay-off is in what and how he has accomplished—not in either the time or the character of his exposure.

Time and experience are not synonymous.

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Contents—May 1953

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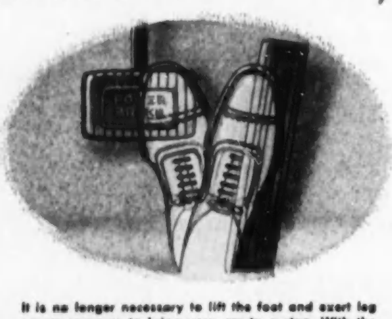

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PRODUCTION TOMORROW

Challenges Engineers Today

E. F. Gibian, Staff Director, Industrial Engineering, Thompson Products, Inc.

Based on talk "Production Tomorrow" presented at SAE National Production Meeting, Cleveland, March 26, 1953.

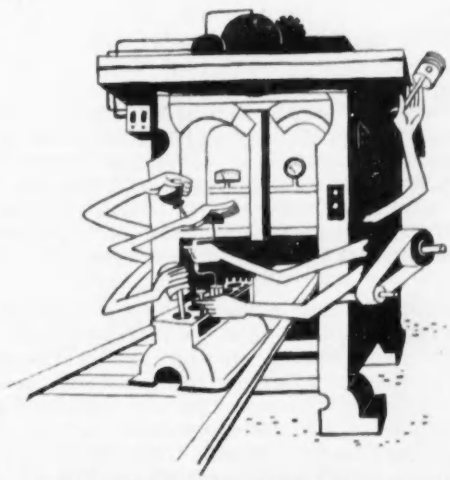
PRODUCTION Tomorrow . . . what a challenge to the production engineer of today!

- **What to look for in tomorrow's machine tools, tomorrow's materials, tomorrow's techniques in casting, forging, powder metallurgy?**
- **What will be tomorrow's role of electronics, and atomic energy in production?**
- **What about tomorrow's management techniques for organizing and controlling manufacturing?**
- **What about tomorrow's management responsibility to meet the social implications of the complex industrial order?**
- **What do we look for in the production engineer of tomorrow?**

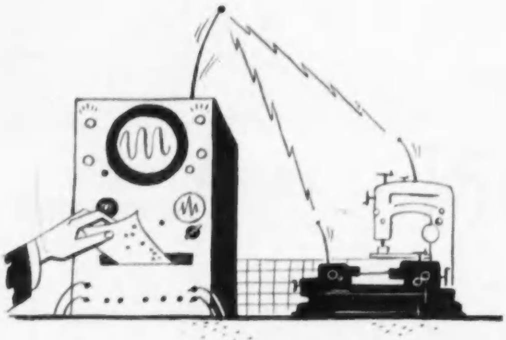
The machine tools of tomorrow are already knocking at the doors of our factories. Not only automation, but the combination of a multiplicity of operations in one machine tool appears to be the trend of the future.

The production lines are being shortened. The continuous line of more or less standard machine tools, served by the conveying system bringing the product of the previous operation to the operator of the machine for the next operation, may be on the way out. It very likely will be replaced by relatively few but more complex machine tools performing the many operations with a minimum of rehandling and repositioning.

Tomorrow's machine tool for large lot or continuous production will be fitted out with a vast array of



". . . more complex tools performing the many operations with a minimum of rehandling and repositioining."



". . . it is conceivable that the engineer will translate his designs not into drawings, but into punched tapes or punched cards to be fed directly into the control circuit of the machine tool of tomorrow."

tools and will be provided by powerful drives to complete simultaneously many operations which up to now are being performed successively on several machines. For example, a machine tool which has been built for the machining of a large jet engine component and is now ready for installation accommodates about 50 cutting tools, is driven by two 150 hp motors, and will complete the entire machining operation now being done by a battery of five large vertical turret lathes. This installation will reduce the machining time from 150 min to less than 5 min!

Built-In Electronic Brains

Electronics and automatic controls will no doubt have a profound influence on the design of new machine tools. The programming of machine tool cycles devised on the production engineer's drafting table or desk will allow the economic manufacture of complex shapes in job shop lots or single samples, eliminating the need for expensive fixtures, cams, and measuring devices.

When machine tool movements will be directed by amplified electric signals, it is conceivable that the engineer will translate his design not into drawings to be furnished to the shop, but into punched tapes or punched cards to be fed directly into the control circuit of the machine tool of tomorrow. Reliable magnetic amplifiers, shock-proof tiny transistors and similar devices, now emerging from the development stage, may vastly accelerate the coming of the automatic control era to the shop floor.

The automatic speed selector of the 1930's, the revolutionary pre-cycling system introduced in the 1940's on the Bullard man-au-trols, may in the late 1950's be looked upon as historic stepping stones in the development of the modern machine tool.

Forging Gets Streamlined

New approaches are already taking shape in the field of forging. The German counterblow hammer pointed the way to the principle of two opposed striking members to convert all, or at least most, of the energy of a hammer into useful forging work, instead of dissipating a large portion of that energy into huge foundations.

The Chambersburg Impacter using two horizontally opposed impellers indicates the possibility of converting the forging of many automotive and aircraft parts into a completely automatic operation at rates in the order of 2000 pieces per hour. The heavy press program sponsored by the U. S. Air Force opens up an entirely new field for the forging industry. Large steel extrusions made possible by the use of a glass lubricant are already a reality. The "throatless" press, while still in the embryo stage, is another example of the many new ideas departing from the conventional concept of this old art.

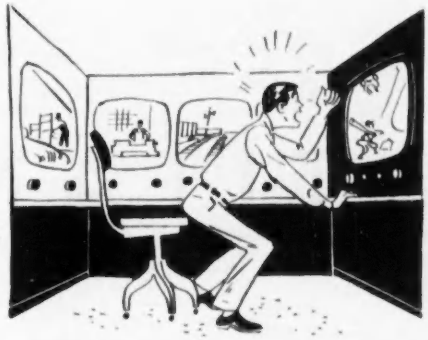
Similar radical advancements are taking place in the foundry. Shell mold castings and frozen mercury investment castings may be cited as examples. New processes, for instance, those employing supersonic vibrations, electrical discharges; new materials, such as, titanium, infiltrated powdered metals, intermetallic compounds, cermets, reinforced plastics . . . these all will tax the ingenuity of the engineers who will plan the production of tomorrow.

". . . radical advancements taking place in the foundry . . . shell mold castings and frozen mercury investment castings . . . new materials such as titanium and reinforced plastics . . . these all will tax the ingenuity of the engineers who plan the production of tomorrow."

Management Controls More Critical

We are also concerned with the technique of controlling the intricate system of tomorrow's production. First of all, we have to learn how to measure, inspect, and keep under control, how to report, and how to correct. The feed-back principle has to be applied to management controls also. We need a better understanding and a broader application of statistical techniques, such as, operations research.

The advent of automatized equipment will call for an entirely new approach to equipment maintenance. Two-way short-wave radio communications within the plant will be available for instant transmittal of information and directions. Industrial television appears feasible for the watching and servicing by one man of several widely separated points in a production process. It may prove its value in the remote control of inventories, the setting of standards, and the control of material movements.



"Industrial television appears feasible for the watching and servicing by one man of several widely separated points."

Military Production Contributes

Many technical advancements touched upon in this review have been accelerated by the impetus of the defense program. The Armed Services have demonstrated an admirable foresight in sponsoring some of the significant production developments. Those of us who work in the automotive and aircraft field gratefully acknowledge the contribution to manufacturing progress made by the Air Materiel Command of the U. S. Air Force, the U. S. Navy Bureau of Aeronautics, and the Army Ordnance, to name just a few.

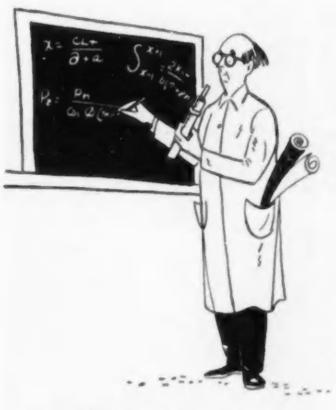
Neither let us forget what production men and machine tool builders are accomplishing in foreign lands, in Great Britain, France, Germany, Switzerland, Belgium, Italy, Sweden, and even on the other side of the Iron Curtain.

Metamorphosis for Manufacturing Man

I would like to close this look into production tomorrow, sketchy as it is, with some speculation on the most important factor in the production process—the production engineer of tomorrow. He too will change.

The production engineer of tomorrow must acquire a grasp of additional engineering knowledge and add it to his present fund of ingenuity, experience, and know-how to comprehend, properly apply, and utilize the scientific advances confronting him. He will need to understand and use statistical techniques and assume management responsibility. He will be forced to work much more closely with the product engineer to insure that the design and specifications lend themselves to the best utilization of available, up-to-date manufacturing tools and equipment. He may have to join that much ridiculed and maligned society of long-haired boys and be at home with integral calculus and differential equations.

Our colleges should take a critical look at the curriculum of their engineering schools, for they may find that the present technical education is not adequate to meet the requirements of the production engineer of tomorrow.



"The production engineer of tomorrow . . . may have to join that much ridiculed and maligned society of long-haired boys and be at home with integral calculus and differential equations."

TITANIUM

Today and

TITANIUM is today being produced and used in tonnage quantities. Producers are spending millions of dollars to boost their capacity to produce pure titanium sponge and to remelt it into commercial forms. Users are developing techniques for forging titanium into aircraft engine parts and for forming sheet for airframes. Titanium represents an appreciable part of the total weight of at least one advanced airframe now in production.

For tomorrow, metallurgists predict new, stronger, more ductile, more heat-resistant titanium alloys—available in quantities permitting commercial as well as military applications. (Part II of this article appearing next month will go into the potentials of titanium as revealed by its metallurgy.)

The two principal producers of pure ductile titanium sponge, DuPont and Titanium Metals Corp., have been turning out 4 tons of sponge per day since the end of 1952. New plants being built at Newport, Delaware and Henderson, Nevada will soon raise total capacity to 20 tons per day, or 7000 tons per year. Still greater capacity, 22,000 tons per year, is the Defense Department's goal for 1955.

Processing Capacity

Melting capacity has been keeping pace with sponge capacity. Huge furnaces (Fig. 1) melt sponge for 1200-lb and even two-ton ingots of commercially pure titanium and titanium alloys.

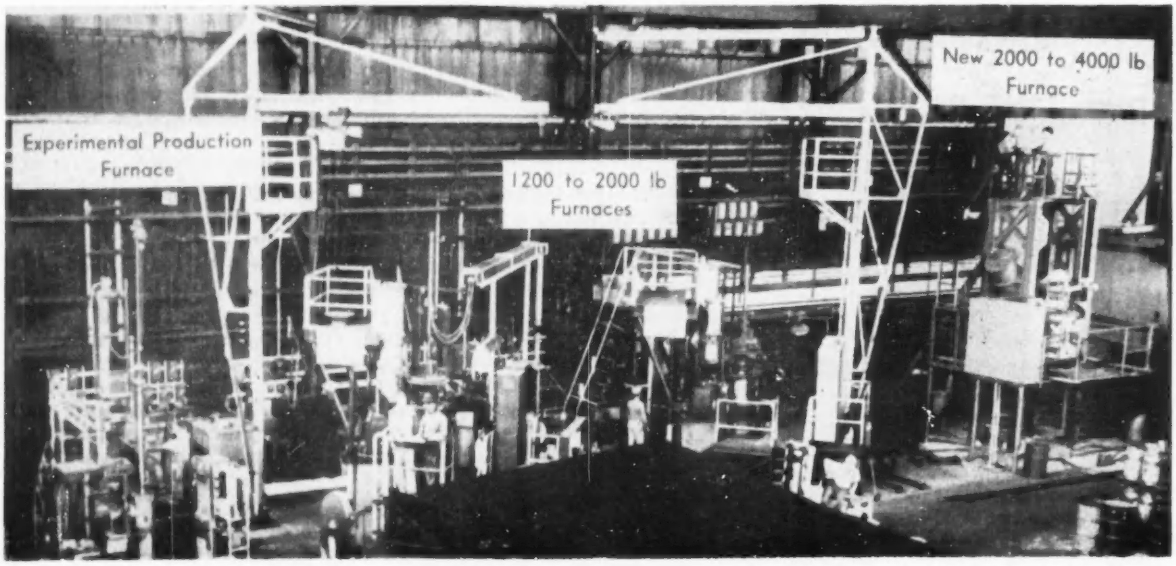


Fig. 1—Rem-Cru's melt shop at Midland, Pa. as it looked last summer. Since then it has doubled in size. Cold-mold furnaces in the rear center turn out 1200-lb ingots. Furnaces at right turn out ingots that dwarf the 1200 pounders

PRODUCTION TOMORROW

Tomorrow

Part I—Today

Mills are working the ingots into almost all of the standard wrought forms that stainless steel comes in. The bigger the ingot, the cheaper it is per pound to process and the less contamination and irregularity in the product. Some of Rem-Cru's big ingots go through Crucible Steel's four-high hot-reversing mill shown in Fig. 2 and on to associated strip equipment to become wide thin strip. Strip up to 12-in. wide is available. Widths up to 26 in. are under development on continuous mills. One sheet of RC-70 has been rolled to 0.015 in. × 36 in. × 460 ft. (Rem-Cru Titanium, Inc., is a joint subsidiary of Remington Arms Co., Inc., and the Crucible Steel Co. of America established several years ago to deal especially with the new metal.)

Sheet and plate come in thicknesses from 0.016 to 1 in., in widths up to 48 in. and lengths up to 140 in. Round, flat, square, and hexagonal bars $\frac{3}{8}$ in. and up are produced with hot-rolled, cold-drawn, or ground surfaces.

Wire Available Also

Users can obtain titanium wire in diameters down to 1/16 in. in coiled or straight lengths. Welded titanium tubing comes in sizes from $\frac{1}{4}$ in. OD up, and in wall thicknesses up to 0.125 in., in straight lengths 10 to 15 ft long.

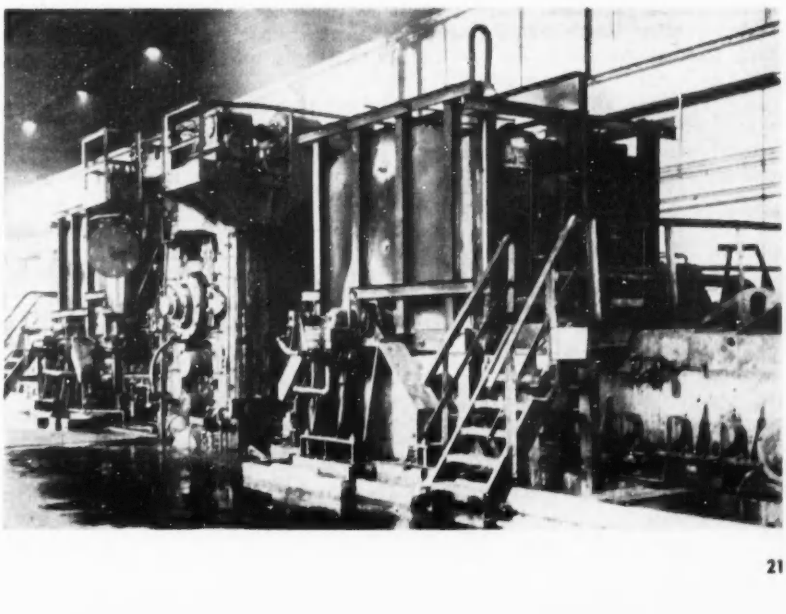


Fig. 2—Crucible Steel's four-high hot reversing mill with automatic coilers contained in the furnaces ahead of and behind the roll stand

THIS is Part I of a two-part article based on:

The Bases for Tonnage Titanium Production

by C. I. Bradford
Rem-Cru Titanium, Inc.

Titanium Alloys for Aircraft Engine Forgings

by L. R. Frazier
General Electric Co.

Titanium Alloy Development

by M. Hansen and H. D. Kessler
Armour Research Foundation

Titanium in Airframes

by F. R. Kostock
North American Aviation, Inc.

Utilization of Titanium and other Alloys in Corrosive Environments

by W. L. Williams
U. S. Naval Engineering Experiment Station

All five papers were presented at a symposium at the SAE Annual Meeting, Detroit, January 16. They are available separately in multilithographed form from SAE Special Publications Department at 25¢ each to members and 50¢ to nonmembers.

Part II of this article will appear in the June issue.

Other articles SAE Journal has carried on titanium are:

"Design and Manufacturing Techniques with Titanium" by O. A. Wheelon in the March 1952 issue.

"Application of Titanium to Aircraft Engines" by H. H. Hanink in the August 1952 issue.

"The New Metal, Titanium" by R. W. Parcel in the December 1952 issue.

Figs. 2 to 7 show how North American Aviation fabricates sheet into airframe parts. This company finds that titanium doesn't like to be worked fast. The stretch press, hydropress or hydroform, and draw press do a better job than the punch press and drop hammer.

North American welds commercially pure titanium without trouble. However, they have found that welding embrittles current titanium alloys and that postheating to recover ductility is more trouble than it's worth.

For forging, titanium suppliers can furnish hammered rounds, squares, flats, discs, rings, and other simple shapes, as well as billets. Ingot size sets the limit on maximum weight for a single forging. With today's large ingots, 4000-lb billets are possible.

Forging Practices

General Electric's West Lynn Plant has been buying titanium shapes and billets and forging aircraft gas turbine parts from them. GE production men find that just about any shape that can be forged in steel can be forged in titanium. But heating time of titanium alloys must be limited. Otherwise a hard, brittle crust forms under the scale. All present titanium alloys suffer from surface imperfections which must be removed before finish forging.

General Electric divides titanium forging alloys into three categories and makes these generalizations about them:

High-Strength Alloys—Sponge melted with aluminum and chromium to make alloys like the 3% Al, 5% Cr Mallory alloy, is good for non-rotating forged parts requiring high yield strengths. They are a good choice for landing gear forgings, for example.

The 3% Al, 5% Cr alloy leads among currently available alloys in yield, stress-rupture, creep, fatigue, and elevated temperature tensile strength. Room-temperature yield strengths are in the order of 160,000 psi. Samples of the alloy tested at 800 F showed yield strengths of 60,000 psi or better. Ductility, as measured by elongation in tensile tests runs between 5 and 10%.

When production men develop a way to surface-harden these high-strength alloys, they ought to be excellent for parts like gears and splines requiring strength plus wear resistance.

Medium Strength Alloys—Alloys like Ti 150A and RC-130B have enough strength to show a strength/density advantage over other materials. They also have enough ductility to adjust to the stress pat-

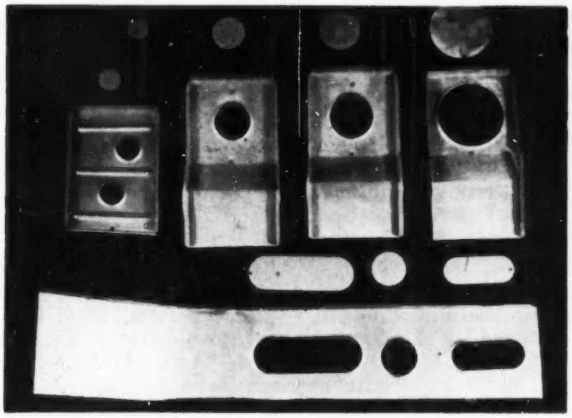


Fig. 3—These typical parts were punched out of commercially pure titanium. Problem with these parts is to maintain flatness. Rework of the dies eliminated fractures shown

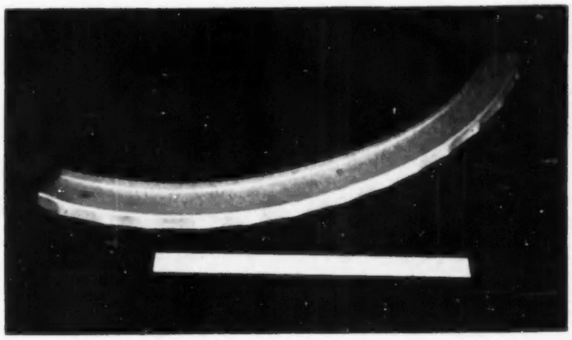


Fig. 5—Titanium stretches well but doesn't shrink readily. In this frame formed cold by hydropress, the upper flange has stretched uniformly to the prescribed greater radius. But the lower flange has buckled instead of shrinking to a smaller radius. There are two solutions: Hot-form the part (Fig. 6) or stretch more and shrink less (Fig. 7)

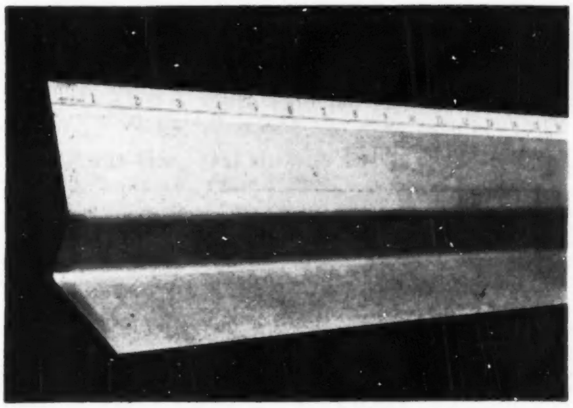


Fig. 4—Sheet stock that bends fine from one surface often fails when bent from the other, as shown here. Lower part of this Z section bent smoothly to 90 deg. But the reverse bend failed at about 35 deg. Presumably one side of the sheet absorbed more oxygen or nitrogen than the other during pack rolling. Pickling the sheet with a nitri-hydrofluoric dip has reduced the failures

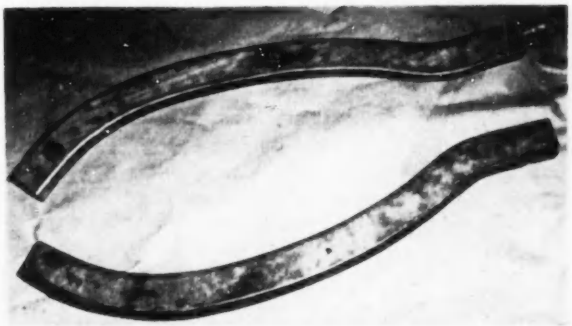
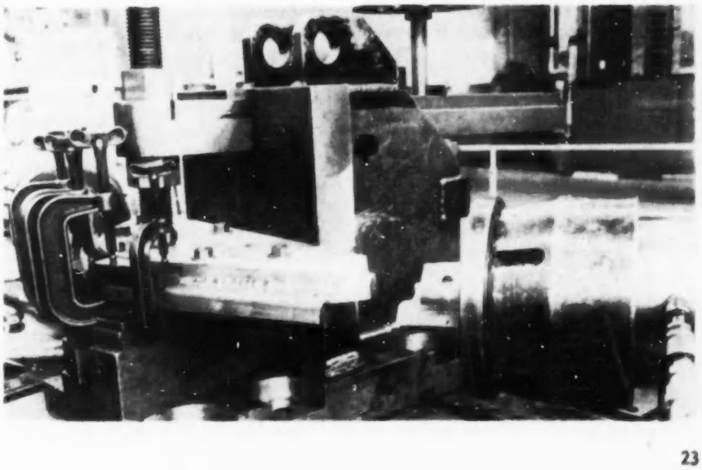


Fig. 6—Shrink and stretch flanges on these parts were hot-formed successfully on the hydropress, although they could not be cold-formed. The cold blanks went onto forming blanks heated to 900 F. Torches heated the blank until it expanded enough for the tool holes to pick up the tool points in the block. Hot blank and die were then covered with loose asbestos fiber to insulate them. A hard rubber pad was fitted over the asbestos-covered pieces, and hydropress pressure applied through the pad.

Fig. 7—This 60-ton Hufford stretch press has been used to form (and here break) curved titanium Z sections. The jaws, like the one at the right, grip the ends of the piece. They give it a stretching load of 28,000 lb dial reading, then wrap it around the die. Parts have been successfully cold formed this way, but this piece broke near the jaw at the right because of laminations in the material.

Stretch presses give especially good results on narrow pieces where it is possible to have the neutral axis inside the inner flange so that both flanges are stretched. When the web is so wide that this would stretch the outside flange beyond its breaking point, the neutral axis must lie between the flanges. But the closer the neutral axis to the inner flange, the less the inner flange is shrunk and the more likely the operation is to succeed.



Why Use Titanium?

Titanium is strong for its weight. Titanium weighs only about half as much as steel and only one and a half times as much as aluminum. Yet commercially pure titanium typically has yield strengths around 80,000 psi and ultimate strengths around 90,000 psi. Commercially available titanium alloys have strengths about double these values.

On a strength/weight basis, titanium surpasses both aluminum and stainless steel in the temperature range between about 250 and 800 F. Parts in and around aircraft turbine engines encounter these temperatures. So will fuselage skins when they reach near-sonic or sonic speeds at high altitudes. (Skin temperatures at Mach 2 at 35,000 ft are calculated to approach 600 F.)

Titanium is ductile. It can be hot and cold formed, rolled, forged, and cut by processes equivalent to those used with other materials in the same strength range. Its elongation in standard tensile tests is between 10 and 25%, depending on the alloy and its form.

Titanium is corrosion-resistant. It resists nitric acid, wet chlorine, chloride salts, organic acids, sulfur and sulfur compounds, and strong alkalis. It appears to be completely unaffected by marine environments. (Part II of this article will include tips on utilization of titanium in corrosive environments.)

terns produced in highly stressed rotating turbine-engine parts. And they are not too hard to machine.

Ti 150A requires some work or plastic deformation below 1600 F before forging. It can't be heated above that temperature after forging without losing ductility. It can be ground satisfactorily if just the right combination of speed, wheel, and coolant is used. The operation must not leave any sharp scratches; they can impair fatigue resistance seriously.

RC-130B offers several advantages over most other medium-strength titanium alloys. It is less sensitive to directionality of properties, grinding cracks, and age-embrittlement. It can be reheated to 1700 F in forging without damage. Besides, it has comparatively higher strength in the 400-700 F range.

RC-130B forges well when the slug is free from surface defects. Ductility is high and relatively uniform.

The results of tensile tests on forged RC-130B titanium discs provide a good example of what to expect from this alloy. Test bars were taken from the center and rim of each disc, from each billet in the transverse direction, and from billet slices forged to approximately one-half their original height. From the data certain observations could be made.

1. Both in the discs and the test slices the high upset ratios produced higher average ductilities.
2. Higher ductilities in the original billets were reflected in more ductile discs.
3. Center and rim ductilities were practically equivalent.

Low Strength Alloys—Forgings of these alloys are easier to machine and grind. Unlike the higher-strength titanium forgings, they can be welded to sheet metal parts.

The low-strength titanium alloys are produced by melting sponge titanium without alloy additions. Alloys in the low-strength classification include Ti 55A, Ti 75A, Ti 100A, RC 55, RC 70, MST Grade III, and Republic's commercially pure grade.

Titanium suppliers will repurchase from their customers clean, segregated titanium scrap at about $1.50 to $2.00 per pound in lots of a thousand pounds or more. Purchased scrap is being stockpiled right now, in the hope that future improved furnaces will accommodate it better. With present melting methods, scrap requires too high a concentration of energy to melt it. It tends to freeze up the molten pool instead of blending with the rest of the charge.

Titanium castings are not yet being made commercially. Chief difficulty in the way of casting is the activity of the molten metal with respect to the mold material. But investigators hope to lick this production problem too before long.

PRODUCTION TOMORROW

coming: THE AUTOMATIC FACTORY

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Excerpts from paper "The Automatic Factory?" presented at SAE National Production Meeting, Cleveland, March 26, 1953.

THE future of automatic processes is inseparable from the future of our manufacturing industries. These processes are potent weapons in the constant fight to reduce costs so that consumption of our manufactured goods may be increased and our employment remain at a high level.

The future of automatic processes at Ford is assured, based on our experiences so far. There is no industry which can afford not to consider the possibilities.

The completely automatic factory is still some distance in the future. We do have some new factories which are based on the automatic handling of parts in some departments. There is no question that the future will see new plants with a greater percentage of automatic operations as our manufacturing engineers and builders of machinery and equipment take advantage of experience gained in the latest programs.

Automatic handling in our factories hinges on five main points:

1. It depends on transfer machinery built with automation in mind. The transfer-type machine combines similar operations to be performed on a part into one continuous machine with automatic indexing between work stations.

2. Automation is another key. It's a coined word meaning the automatic handling of parts between progressive production operations.

3. Preventive maintenance programs are needed to keep our production lines in operation. This includes tool changing and the standardization program which is so important in a modern plant.

4. The emphasis has to be switched from muscle power to brain power. That has to be done through a reorganization and reallocation of work tasks and manpower.

5. It takes alert management to coordinate and get the best out of each of our technical skills.

Many of the features discussed in the following article are shown in the photographic tour through Ford's Cleveland Engine Plant on pages 38-45 of this issue.

To see how Ford has tackled these problems, read the next five pages

1. Transfer machines combining a number of operations introduce new concepts in manufacturing operations.

A few years ago, processing of parts manufacturing was based on a series of individual machine tools to perform the operations in small increments with manual handling between each machine. Processing today would and must be based on the combination of similar operations into an integrated machine tool of many stations, with automatic transfers between.

To illustrate the techniques used we can consider the production of automotive crankshafts. One portion of our machining process involved the drilling of six oil holes, six metering holes, six lightening holes, and inspection of the operation.

Ten years ago 29 separate machines would have been required, while today the same department would require only three transfer type machines of eight stations each. The part would be loaded at one end and unloaded at the other end with all operations in between being completely automatic. This example applies to other operations such as milling, broaching, reaming, and tapping.

This combination of operations describes the machine tool which is known as the transfer machine. We can readily see that combinations of this type cause profound changes on our entire production process. Our manpower must be redistributed to handle the problems which arise.

We must take a fresh look at our methods of maintaining machinery elements and in applying our tools to the job. We find ourselves with production lines which in many cases are made up with groups of transfer machines which are completely automatic in themselves. These machines in turn must be coupled together in an economical fashion if we are to gain the full benefits of the transfer machine.

2. One big new engineering field opened is automation, the automatic handling of parts between operations.

We can see that while similar operations are combined with transfer machines, there is a separate problem still remaining. That's to connect these new machines so that manual handling operations between the products of the various machinery builders will not be necessary.

It is up to us to see that all the engineering groups involved are properly coordinated so that our automation devices can be designed with the necessary elements. Included are such elements as simplicity, ease of maintenance, and use of standard design details for the various sections necessary for a complete department.

Automation devices are designed to move parts into and out of production machines, turn the part over, rotate it, remove scrap and other related functions. Scrap removal on a continuous and automatic basis was a necessity in both machining and stamping operations. These devices are timed with the process and are ordinarily completely automatic while in operation.

A finished piece of automation equipment is made up largely of standard elements such as conveyors, air, hydraulic, and electrical control mechanisms. These are arranged to obtain the proper movement for elimination of unnecessary manual handling operations.

We have found that a wide variety of materials can be handled with substantial savings. At the same time we can eliminate hazardous handling such as in large stampings, heat treat operations, forging operations and others. In many respects automation is the extended usage of conveyors which played such an important part in the early development of mass production of automobiles.

In the Ford Motor Co. proper emphasis has been placed on automation since the Spring of 1947, when our first Automation Department was set up. We have found that the entire program has been accelerated and that the necessary coordination has been possible since that time.

There are many groups in the various divisions of our company which are working on this problem. Automation has been set up on a sound engineering basis, instead of the cut and try method which was often used in the past. We have been able to place proper emphasis on design to obtain simplicity and to eliminate maintenance problems after installation, as well as to obtain completely automatic operations. The individual and specialized treatment possible with this type of system has produced results which could not have been attained on any other basis.

The early automation programs at Ford were

centered about rearrangement of standard and existing machines to connect them with mechanical devices which would eliminate the inherent delay caused by manual handling. Many arrangements of this type were worked out to lower production costs.

At present, we find that our new programs are based on the wide introduction of machinery and equipment which have been designed with automation in mind. This program is planned so that automation will be considered in all programs.

3. Automation can pay off in (1) lower costs, (2) higher speeds, and (3) higher quality, and (4) greater safety.

As we all know, lower production costs are an important consideration in all facilities planning. Automation assists greatly by relief of manual effort required in handling parts and the resultant inherent delay, especially in large volume operations.

This does not mean elimination of all manpower, but rather a redistribution of manpower which will result in the need for more skilled workmen. It eliminates monotonous, repetitive work in many cases while at the same time increases production. We have found it possible to make worthwhile direct labor savings.

Very often the speed at which a machine produces a part is determined by the loading and unloading operations. Automatic transfer between operations has resulted in greater use factors for machines. The machinery has been able to operate closer to its designed capacity.

Using high cost machinery to a greater degree is a definite advantage. We have found, for example, that in some press lines it was impossible to load the presses fast enough by hand to keep them running continuously. Automation made it possible to do this on many machines. The connection of all elements of a production process for a complete synchronization is a reality and has been accomplished on many of our machine lines.

Less scrap and fewer rejects often result from the use of automation. This helps this program by reducing damage caused by parts hitting each other or falling to the floor.

The handling of cumbersome parts manually can, at times, become quite hazardous even with the best safety devices. Use of automation to handle stampings into and out of presses and at turnover operations for many parts are good examples of this type.

4. But if it isn't properly designed, maintenance costs will skyrocket, breakdowns will wreak havoc with schedules.

In discussing automation with others in manufacturing from other industries, we very often find that there are disadvantages which appear as stumbling blocks to the use of automation. We usually find that these disadvantages have not been analyzed to their fullest extent in evaluating the program.

Maintenance costs are usually brought up in discussing automatic equipment. Use of automation devices in the production processes naturally causes maintenance problems which could offset the savings to be made if not properly handled. Many departments have become nearly 100% automatic. Because of this, any breakdown of even the smallest element can shut down the entire line.

This maintenance problem has been minimized as skill in automation design has increased. We have simplified the details of the systems. Many of the devices have been made more substantial and preventive maintenance has become a must in our plants.

Engineering costs are common to all engineering endeavor, but are especially important here because of the need for coordination of so many elements . . . plant layout, tool design, die design, machine tool builders, material handling engineering, and others.

Much careful planning and hours of work are necessary before construction can start. Three-dimensional models are sometimes developed and more often perspective drawings are made as part of this plan.

Installation costs are normal in considering any piece of production equipment. In studying existing operations, however, an unusual problem arises. It is often necessary to rearrange machinery. This can be an expensive operation. However, we have found many cases of this kind where the advantages to be gained made this type of program possible. Proper planning can make the installation of automation devices occur at model change time, when rearrangements are often necessary due to changes in processing.

5. Designing automation equipment calls for a new breed of engineer and a fresh approach to overall planning.

Each product studied requires special consideration. We manufacture a wide variety of parts of different sizes and shapes and the machinery and production equipment we use varies in size. Our present setup of proper emphasis on automation makes it possible for us to study the problems at the beginning of new programs. In that way standardized automation devices can be used to minimize this problem.

The development of automation equipment is very often not a simple process. Much engineering study is required. To indicate the work required, we would like to explain how we handle a new program.

At the present time, we have people in our company who are specialists and concentrate on automation design work. An automation designer must have imagination, engineering knowledge, and design experience. He must think in terms of equipment, which very often is a compromise between the comparatively loose standards used for designing a conveyor and the close standards utilized in normal tool and die design. This is the type of man who starts analyzing a program in the first step when the general plant layout has been agreed upon and detailed layouts are in their early stage.

We ordinarily give one automation engineer responsibility for the work on a complete part. As the detailed plant layout is developed, the automation man must be readily available for consultation so that arrangements can be made for the installation of the simplest possible transfer mechanism. At this point in the process many interested parties from production and higher management view the developments to see the overall plan.

It is the time for quick calculations and simple sketches to help determine in a preliminary way the extent of automation justified by the economics and other related factors. We quite often find that the right type of automation equipment costs very little more than standard conveyances which must be supplied as a minimum. We can see here the value of close coordination on the program at this point and it must be strongly emphasized.

The part to be produced must be carefully studied for adaptability to automation. Preliminary manpower estimates must be considered. We may find that one operator can load and unload several or more machines, or he may be required for assembly, manual control, observation, or others; and automation may not be necessary.

Once we decide on the plant layout to be used, copies are made and the automation engineer starts his detailed study for determination of the complete program. An overall preliminary automation layout is made. It shows all of the elements required. In some cases models and three-dimensional drawings are made to be certain of some of the details and to make proper presentation to management for approval.

This preliminary automation layout is then analyzed for estimated installed cost.

Our Industrial Engineering Department analyzes the manpower requirements for the entire layout both with and without automation. When these are completed, we then have cost figures which enable us to make a proper decision as to the extent of automation which may be required. These data are summarized and presented to management for approval.

When the program is approved, the really important work begins. The plant layouts which were developed must be revised wherever necessary so that the automation equipment is allowed adequate space.

The Processing Department revises its operation sheets where necessary to include the effects of the automation equipment.

The Tool & Die Design Department is consulted so that proper coordination takes place. It is important that clearances are left in dies and tools for introduction of automation devices to load and unload work.

The machinery and equipment builders are consulted so that work heights are standardized and they realize the type of program which is being planned.

At this point it is possible to make a final automation layout and we are ready to proceed with the procurement of the equipment.

Since automation equipment is a key item in a production process, we feel that the method of placing all of the responsibility with one party is a much better one if it can possibly be used. Even assuming that this method is utilized, the automation program is incomplete until the job is actually operating successfully. For this reason the automation engineer must continue to follow the program until the entire system is in operation.

It is necessary to keep in close touch with field conditions to take care of needed minor changes as the various other items of production equipment are installed in their proper places.

By now, you have probably all wondered about the economics which determine the value of an automation system.

Expenditures for machinery and equipment must be examined for their value to the entire company. Automation expendituures also fall in this category. They must be expected to produce results in terms of increased production, lower costs, better working conditions, or other benefits.

It is important that a true picture of the estimated cost savings and all financial factors are brought out to prevent the expenditure of funds on schemes which sound reasonable or may be spectacular with very little benefit. We in the automobile industry find this problem especially sig-

nificant since many of our parts become obsolete after one year. In cases of this kind, it is apparent that systems which do not amortize themselves in less than a model year are not economically advisable.

We do find that there are many cases in our press lines for body parts, and machining lines for engine and chassis parts, where longer amortization periods are permissible. Very often on some of these parts, the basic system can be used for several years since the year-to-year changes would not make the equipment obsolete.

Another point to remember is that in many cases correctly designed automation equipment costs very little more than minimum standard conveying devices. Because of this, automation thinking must be brought into a program from its inception.

In our Cleveland Engine Plant, a department manufactures cylinder blocks at a rate in excess of 2000 blocks in 16 hr. The machinery and equipment is all new and of the latest design with many new transfer type machines. In our original plant layouts, roller conveyor was considered throughout. The production capacity was such that the department was made up of several machine lines.

As the operations progressed, they were split up from one machine per operation to two or three machines per operation. For a standard roller conveyor system this meant many large radius turns and manual handling of parts for proper distribution of parts to the machine lines. Also, there were several places where it was necessary to turn the block over to rotate it at 90 deg which resulted in manual operations. Nearly all machine operators had to handle a part in some way.

Our Automation Section studied the plant layout using the method we have outlined and their analyses indicated the need for automation equipment. The plant layout which developed was more compact. A system of automation was developed which was an extension of much of the work which had been done by the machine tool builders as part of the machine. The labor required for handling of parts approached the vanishing point. The entire department became a synchronized system and functioned as one large transfer machine. It is not necessary for any operator to push, pull, turn-over, or position a part.

The economics of the study indicated that the system would cost more than the standard system previously proposed; but that it would amortize itself in a comparatively short period.

Looking at it from the overall standpoint, labor was reduced substantially. We found the need for considerably less direct labor, but for an increase in the categories of indirect labor which had to do with the servicing of the machines to keep the automatic processes in operation. In effect, the manpower used was to watch the various operating mechanisms so that defects could be sighted before they became major breakdowns.

This example of how an automation study improved an entire operation, we believe, points out the most important point in the entire program. Maximum economy of installation and savings in handling operations can only be obtained when the plant layout is in its early stages. Automation must be considered as a tool to do a given job, just as we select drills, mills, broaches, presses, and other types of machinery to produce a part as specified.

6. Good design must be implemented with preventive maintenance to prevent disastrous shut-downs.

Maintenance of automatic machines and automation equipment is a new challenge to our resourcefulness. As we have pointed out, the breakdown of even one small element will shut down the entire production line.

Our answer to this new problem is preventive maintenance. It is a must for the modern production line based on continuous low cost production. In the past, maintenance was based on repairing equipment after it had broken down. This approach is not satisfactory today. Our entire production system is geared to a uniform production rate per hour without the possibility of making up lost production due to breakdowns.

Preventive maintenance is the key to continuing production and involves generally the keeping of accurate records of lubrication, expected life of perishable parts, and replacing these parts before they fail and stop production.

To set up a modern preventive maintenance program requires a considerable amount of forethought. Just as in the design of automation equipment, our plans must start in the early stages of the program if we are to take advantage of modern procedures.

Let us look at some of the things that we are doing to make the maintenance job simpler.

One of the very effective tools which can be used is a standards program. At Ford this includes standardization of tools, methods and specifications, industrial equipment, process standards, and material standards. These standards are based on exhaustive surveys of alternate methods before they are accepted.

Benefits from a standards program are directly applicable to the preventive maintenance program. Standardization simplified the procurement program, and greatly simplified the problem of keeping adequate supplies in stock for necessary repairs.

We would like to mention a few notable examples of what has been accomplished.

As an example, the standard tool layout has cut down tool change time to a minimum. This single item is used widely throughout our new production lines. In our Cleveland Engine Plant, it is used in conjunction with our automatic tool control board, which is a recent development and already is accepted as an outstanding feature of our maintenance program.

By means of this system, a supply of tools for a

given transfer machine is kept adjacent to the machine. There is a definite location in the board for each tool used. Each tool on the board has been preset in accordance with our standards so that it can replace a worn-out tool without adjustments on the machine.

Each tool is represented by a toolometer dial which connects to the machine. The pointers on the dial are set at a predetermined number of pieces, depending upon the known life of the tool just prior to need for a re-grind. When any particular tool has reached the predetermined number of pieces the machine is automatically shut down.

By scanning the tool control board, the set-up man can readily determine the tools requiring immediate changing. He also selects other tools to change at the same time where the indicator pointer has reached the red "danger" area. Through this preventive maintenance method of changing tools, machine down time is held to the absolute minimum.

Another important factor is the use of Joint Industry Conference Standards, which are a collection of sound engineering and installation practices. They provide detailed specifications for the application of electrical, hydraulic, lubrication, and pneumatic apparatus to machine tools and other industrial equipment.

7. More skillful labor and management too will be needed to get the most out of the factory of tomorrow.

Our discussion of the factory with automation brings out the fact that our production processes are becoming much more complicated. We have been successful in many cases in removing that portion of the labor which was largely devoted to manual handling of parts.

When we do this, our production processes very often become a series of departments producing different parts which are in effect one large transfer machine.

When we select the men required to run these departments, we are more concerned with their ability to keep them in first-class condition and to recognize when troubles are threatening.

From this you can see that, in general, your production people will be more highly trained on the average than in the past. To attain the type of worker required, you will find that the scarce skills are not ready-made. The factory management of the future must be prepared to assist in this training program. The reward to the worker will be that jobs will be less monotonous and boring and that, if properly trained, he will become more interested in his job.

Behind the production worker we will find more highly trained technical people. The greater complexity of our operating production lines necessitates this.

Each of the elements of manufacturing engineering ties in with the overall production line so closely that a breakdown of any phase of it means a shut-down. Poor planning of the various automatic features needed will cause greater loss in production than ever before in the past.

As we can see from the development of our own Automation Department, a higher skill was necessary in designing the equipment involved than was formerly needed for the comparatively simple devices such as roller conveyors, simple belt conveyors, and other similar items which automation replaced. Specialization among technical people will, in many cases, become more pronounced; but it will be necessary for the various engineering groups to understand the problems of the other departments.

Because of this, you will often find the need for supplementary training for the engineering specialists. This is especially important in modern industry. Again we refer to our problems of automation in which it is necessary for the automation engineer to coordinate the activities of several different groups to obtain a successful installation.

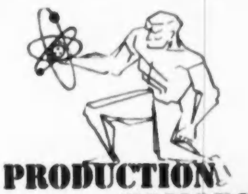
We can sum up the manpower situation in the factory of the future by saying: There will be a much greater use of brain power throughout the entire plant to replace a large portion of the muscle power which we have been accustomed to in the past.

The factory with automation which we are talking about today and which now exists in important segments, represents the maturity of manufacturing methods. This maturity which is accomplished by the utilization of the best of engineering thinking has coincided with the greater utilization of specialists throughout the manpower structure of our plants. This, of course, means a larger number of individual departments working on the development and operation of new facilities. With this has come a much greater reliance on detailed studies to obtain all of the facts about proposed modernization and expansion programs.

This combination of factors places a new emphasis on the management of our factories. The top management of our plants must be able to promote team-work in the entire organization so that all phases of production planning are coordinated. Plant management must keep itself flexible to make the best out of the various technical skills available for planning purposes.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Canyon-like foundation pit for massive forging presses—graphic proof that . . .



PRODUCTION TOMORROW

Big Doings Mark Coming of Monster Presses

FORGING and extruding giants capable of squeezing huge chunks of metal into aircraft structural parts will swing into action soon. Pride and joy of the U.S. Air Force, these big fellows are being counted on to spark U.S. progress toward ever better aircraft.

The U.S. Air Force is spending almost $400,000,000 to develop some 400,000 tons of press capacity in seventeen of these monsters. (Table 1 lists the presses on order, where they're going, and when.) This stable of "heavies" will dwarf the largest presses now in operation in this country. Whereas the highest capacity forging press today is a mere 18,000-ton job (See Fig. 1), the Air Force program calls for 25,000-, 35,000-, and 50,000-tonners. As for extruders, the biggest units today push with a force of 5500 tons, but on the way are 20,000-ton giants.

But before this new species of machine tool gets baptized, a whole raft of problems must be solved and a near-empty reservoir of knowhow filled up. Such machines take goliath parts, huge billets, and finicky operating techniques to yield sound parts. But day by day obstacles are being met and overcome.

Why the sudden passion for these behemouth presses? The trend toward faster, higher-flying, larger aircraft spawned them. Such planes need

Table 1—Heavy Press Delivery Schedule

Operator	Press (tons, type)	Builder	Delivery Date
Reynolds, Phoenix, Ariz.	12,000 Ext.	Lombard	November 1953
Reynolds, Phoenix, Ariz.	8000 Ext.	Loewy	Dec. 1, 1953
Alcoa, Lafayette, Ind.	14,000 Ext.	Schloemann	End of 1953
* Dow, Midland, Mich.	13,200 Ext.	Hydraulik	End of 1953
Wyman-Gordon, North Grafton, Mass.	50,000 Forg.	Loewy	Jan. 1, 1954
Kaiser, Halethorpe, Md.	8000 Ext.	Loewy	Jan. 1, 1954
Curtiss-Wright, Buffalo, N. Y.	12,000 Ext.	Loewy	Feb. 1, 1954
Harvey, Torrance, Calif.	8000 Ext.	Loewy	Feb. 1, 1954
Kaiser, Newark, Ohio	25,000 Forg.	Bliss	February 1954
Wyman-Gordon, North Grafton, Mass.	35,000 Forg.	Loewy	March 1, 1954
Alcoa, Lafayette, Ind.	20,000 Ext.	Loewy	March 1, 1954
Kaiser, Halethorpe, Md.	8000 Ext.	Loewy	March 1, 1954
Harvey, Torrance, Calif.	25,000 Forg.	Baldwin	May 1954
Harvey, Torrance, Calif.	35,000 Forg.	United	August 1954
Kaiser, Newark, Ohio	35,000 Forg.	Bliss	September 1954
Alcoa, Cleveland, Ohio	35,000 Forg.	United	November 1954
Alcoa, Cleveland, Ohio	50,000 Forg.	Mesta	December 1954

Courtesy of Aviation Week

Table 2—Gains with Integrally Stiffened Part* Over Conventional Construction

	Conventional Design (120,000 lb Gross Weight)	Integrally Stiffened Design (130,000 lb Gross Weight)	Savings Over Conventional
Total number of detail parts	1,806	334	1,472 parts or 81.5%
Total attachments: rivets, screws, bolts, nuts, etc.	41,000	*7,224	33,776 fasteners or 82.4%
Weight of sealant (lower portion of wing only)	80 lb	30 lb	50 lb or 62.5%
Total weight of structure including all parts & sealant	1736.9 lb	1442.4 lb	294.5 lb or 17.0%

* Part is the inner wing lower surface for the Super Constellation

stronger, larger structural parts—parts that are light, aerodynamically smooth, and easily pressurized. And it's important that they be fabricated as cheaply as possible.

One Piece Beats Bits and Pieces

Air Force men knew there were only two ways to make such large parts . . . build them up of bits and pieces or make them in one piece. Table 2 shows some of the savings possible with an integrally stiffened structure. However, it tells only part of the story.

Integral structures deliver more performance for less weight. Take as an example wing skin structure. Because there are practical limits to closeness of spacing of attached stiffeners, only about 80% of the skin area is put to work in standard bits-and-pieces makeup. But with integral construction, it all becomes effective. In short, integral structures are better able to meet the space limitations set up in thin wings with high structural loads.

What's more, since one-piece jobs make for fewer fasteners, attachments, and joints, smoother aerodynamic surfaces and easier sealing are obtained.

Opportunities for cost reduction are everywhere, too. Many bits and pieces can be eliminated. Direct assembly manhours and tooling costs can be cut. And because there are fewer parts to handle (see Fig. 2), a number of other economies fall right in line . . . in production control, stocking, inspection, transportation, and tool planning. Of even greater importance, better performance and weight reduction can be had for no increase in cost.

Why Forgings and Extrusions

Integral structures can be made by a number of processes—rolling, casting, hogging from a plate or billet, forging or extruding. Why, then, all the furore for large forgings and extrusions? It's because they offer the most efficient structure for the money.

Hogging or machining from a plate or billet takes tremendous machines and many machine hours. And machined parts don't have as consistent mechanical properties as parts forged or extruded to finished or nearly finished dimensions. There's also some question as to the mechanical properties in the center of a thick plate or billet. Forgings have the added advantage of variable grain direction, which generally can be tailored to the stress patterns of a specific design. Another drawback with machining is the large percentage of stock that goes into chips.

Casting materials don't have sufficiently high physical properties. Nor have casting techniques developed to the point where efficient metal distribution and thin sections can be obtained.

So large forgings and extrusions can do a better overall job. But to satisfy today's aircraft needs, large forgings especially will have to be better in many ways than those available today. Improvements will have to come in these areas:

1. Draft angles will have to be kept to a minimum. Using present standards, the percentage of draft

material in large forgings would be tremendous. Even in those few cases where weight is not paramount, draft angles may interfere with mating surfaces. Thus, draft will have to be eliminated in the forging operation, not removed by machining later on.

2. Tolerances will have to be cut for pretty much the same reasons. Forging draft and tolerances can require rework of as much as 238.6 lb from a 400-lb forging. With extrusions, tolerance reduction will have to come from improved die material, precision in die making, and accurate control of the extrusion operation.

3. Section refinement will be needed. Increased pressures will make possible forgings and extrusions with thinner webs or sections; greater ratio of stiffener, legs, or protuberance height to thickness; reduced fillet and corner radii.

4. Delivery time will have to be reduced. Forgings and extrusions will have to be available not more than six to nine months after the order has been placed, so that airframe makers can reduce delivery time on prototypes. It may be necessary to establish a die-block material pool and arrive at a solution to the shortage of die sinkers.

This article is based on papers presented at the Symposium on Heavy Presses for Light Metal Forgings and Extrusions held at the Annual Meeting of The American Society of Mechanical Engineers, New York, Dec. 2, 1952. This all-day session was cosponsored by SAE, ASME, IAS, and AIME. Symposium of these papers is available from ASME, 29 West 39th Street, New York City.

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Today's Billets Dwarfed

The size problem is plaguing everyone connected with the heavy press program, starting with the supplier of the strong aluminum alloy ingots.

For example, to date the largest cross-sectional ingots forged in Wyman-Gordon's 18,000-ton press are 15 in. square ingots weighing 850 lb. But the 50,000-ton giant in the works will take 28 in. square, 8000 lb hunks . . . and rectangular jobs, 28 in. thick by 45 in. wide, weighing up to 12,000 lb! With extrusion presses, it's much the same story. Right now a 5500-ton press can handle billets up to 16 in. in diameter that weigh up to 2800 lb . . . the 20,000-tonner on the way will take round ingots twice that diameter and three times the weight! (See Fig. 3.)

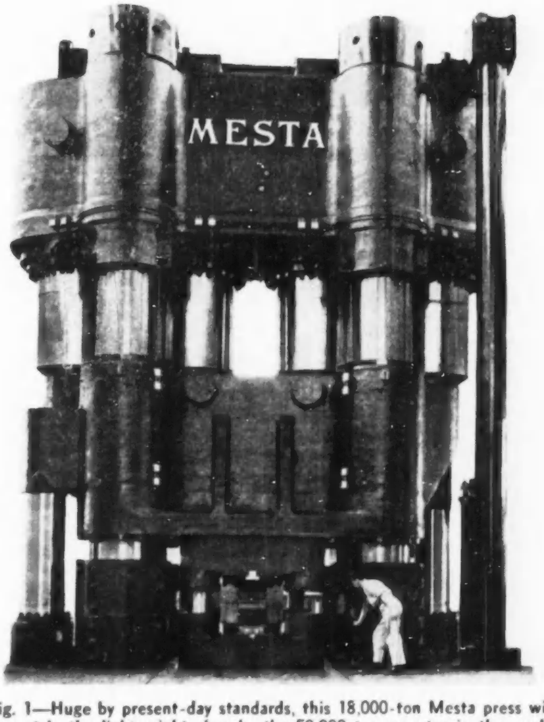


Fig. 1—Huge by present-day standards, this 18,000-ton Mesta press will be put in the lightweight class by the 50,000-ton monster in the works

To be metallurgically sound for forging and extruding, aluminum alloy ingots must be uniform as possible in chemical composition; fine in grain structure; free from cracks, harmful porosity, and nonmetallic inclusions. But the bigger an ingot gets, the tougher it is to get these properties.

Metallurgists have tabbed the direct-chill method for casting large ingots as "most likely to succeed" . . . but even with it casting techniques will have to be improved. Before discussing why, it might be well to explain how the direct-chill process works.

A sketch of equipment used for casting a 32 in. diameter 14S alloy is shown in Fig. 4. Molten metal is poured into the short, circular, water-cooled mold which is temporarily closed at the bottom. After solidification of the aluminum alloy first poured into the mold, the partially solidified ingot is lowered at a controlled rate through direct water sprays. (Lowering of the ingot is synchronized with the rate at which molten aluminum enters the mold.)

The fast chilling that results generally gives fine grain structure and less variation in chemical com-

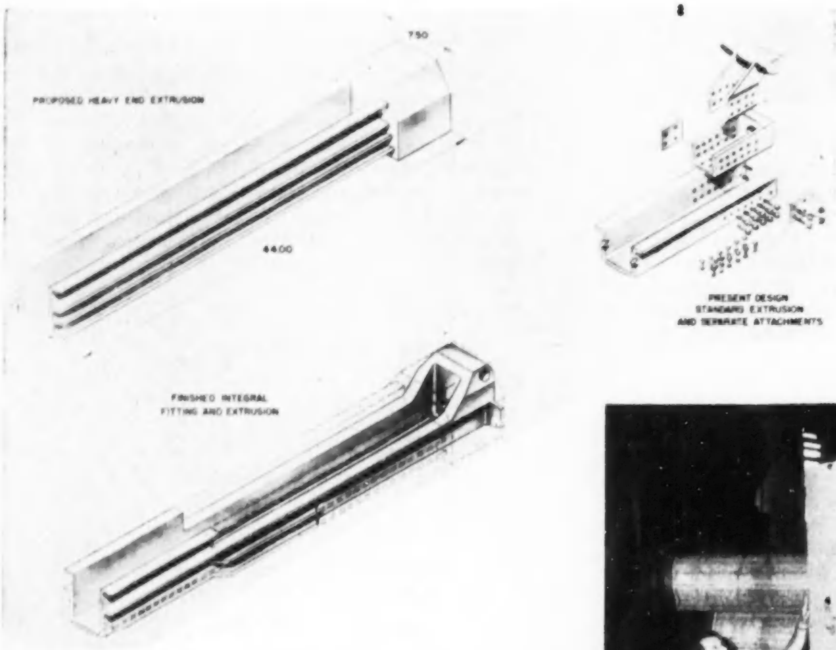


Fig. 2—Integral design eliminates many of the attachments and detail parts of "bits and pieces" construction

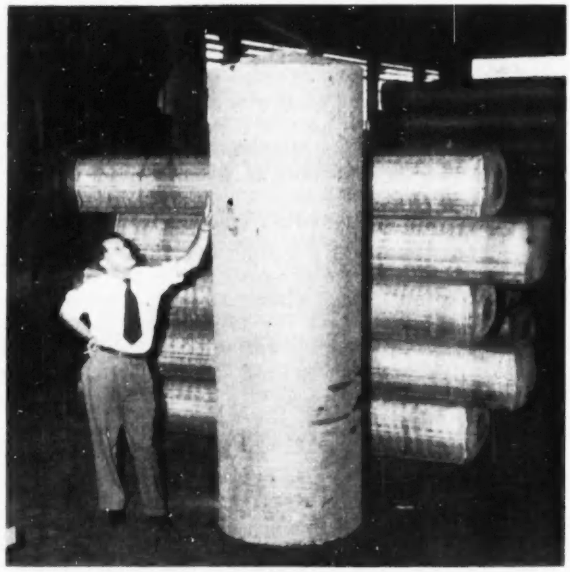


Fig. 3—Huge billets can be pushed through coming extrusion giants. Problem is to get metallurgically sound stock.

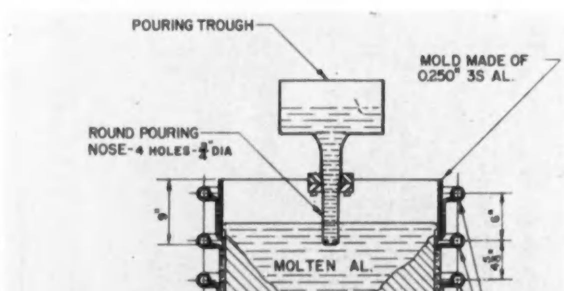


Fig. 4—Equipment for direct-chill casting of large ingots. Metallurgists have tabbed this method as "most likely to succeed" in providing metallurgically sound stock for the coming forging and extruding giants

position than that obtained with any other method of casting. But it spells possible trouble in other ways.

Ingots of strong aluminum alloy have a marked tendency to crack when cast by the direct-chill method. And this susceptibility to cracking rises both with increase in cross-section area of the ingot and the rate at which it is cooled. Too rapid cooling of a large ingot causes stresses to develop due to temperature differentials throughout the huge hunk of metal. And the stress imposed upon central portions of the ingot, which are restrained in contracting during cooling by the colder outer portions of the ingot, can cause splitting and cracking.

On the other hand, too slow a cooling rate may bring sorrow, too. If the heat extraction rate is such that a wide solidification zone results, the gases liberated as the liquid freezes don't get a chance to pass off. What's more, there may not be enough liquid available in the mushy metal to fill all the interdendritic spaces. Porosity and gas entrapment, then, may be the end products of too slow a freezing rate.

Finding ways to reduce the crack-inducing temperature differential in large ingots and to obtain ingots free from harmful porosity are the current objectives of ingot suppliers. And they have several good leads. One of them involves using "wipers" to remove water from the surface of the ingot a short distance below the mold. This would narrow the solidification zone and, by permitting heat to be retained in the bottom portion of the ingot, would tend to equalize temperatures in the ingot. Use of larger molds is another approach that offers possibilities.

Thus, billet suppliers are confident they will be

able to come up with metallurgically sound stock for the heavy press program.

Press Makers Need No Magnifying Glasses

Huge as these billets will be, the physical dimensions and weights involved in the presses themselves dwarf them by comparison.

For example, many of the component castings of the 20,000-ton extrusion press will weigh as much as 425,000 lb. (Fig. 5 shows a "small" 214,000 lb casting for the 13,200-ton extruder arriving from Germany.) The press itself will tip the scales at 7,000,000 lb, with auxiliary equipment adding another 4,000,000 lb. And the giant will stretch out some 140 ft—not counting runout table length of 150 ft—and stand 27 ft high, with 17 ft above floor level. As for forging presses, the 35,000-ton job will tower some 50 ft above the floor, will weigh in at 10,000,000 lb, and it, too, will have castings in the neighborhood of 450,000 lb. (See Fig. 6.)

Equally gigantic are the forging pressures that these machines will be able to build up, especially in thin-walled panels. Values of over 60,000 psi will not be uncommon. And press designers know that even the massive parts in big presses will deflect under the high compressive stresses necessary to get these forging pressures. They also know that such elastic deformations can be the cause of real forging inaccuracies.

For instance, when a 25-in. diameter "pancake," of 7/16 in. average thickness, was produced between flat dies on the 18,000-ton press at Wyman-Gordon, thickness at the center was 0.560 in. and only 0.315 in. at the edge. So thickness varied by 0.245 in. over a distance of only 12½ in! What's more, it has been demonstrated mathematically that even if this pancake were compressed between two semi-infinite solids, there would be a thickness variation of 0.158 in.

It's the press designer's job, then, to compensate for these deformations. Fortunately properly tapered dies will squeeze out panels of essentially constant thickness . . . and these dies can be obtained by a series of trial and error solutions.

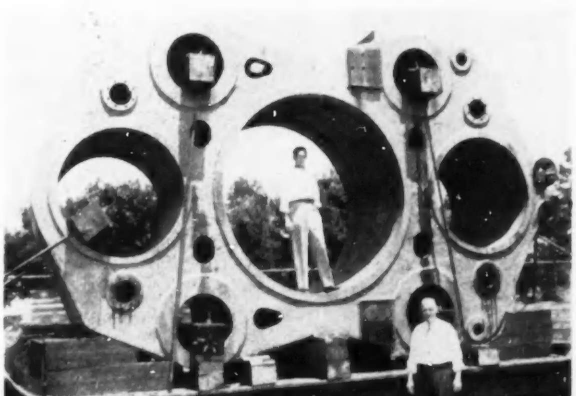


Fig. 5—One of five goliath, 107-ton castings that will form the backbone of the 13,200-ton extruder. The part is shown arriving from Germany

Why Squeezing, Not Hammering, Giants?

ALL nine of the monster forging machines being built under the U.S. Air Force heavy press program are enclosed-die forging presses. Nary a one is of the drop forging variety. That's because presses were found to have all these advantages over drop hammers:

- **Far greater die life due to absence of impact in the forging operation**
- **Smaller draft angles required due to one-stroke operation and use of ejection facilities**
- **Closer tolerances possible since dies are held in alignment during complete forging cycle**
- **Both upper and lower die temperatures can be kept constant, resulting in less shrinkage and mismatch**
- **Production rates can be doubled, especially on larger and heavier forgings**
- **Complicated forgings requiring undercuts and internal bores can be fabricated.**

But this isn't the only way that dies will have to be improved. Forging and extrusion dies have always been ticklish creatures to design . . . the giant presses will make the job even more difficult. Not only will they make possible immediate use of larger and more complicated dies, they also can be expected to use bigger and bigger dies as time goes by. For example, Fig. 7 shows one of the first dies used on Wyman-Gordon's 18,000-ton forging press; Fig. 8 shows one of more recent vintage.

As forging dies get larger, they tend to be less sound and uniform toward the center. Eliminating such defects calls for pretty close cooperation between maker and user of the block.

What's more, delivery time of die blocks for large forgings is too long. Maintaining a stock of such large blocks is economically unsound, but it will have to be done if present procurement time isn't reduced.

As for extrusion dies, even now it's impossible to build a die for complicated shapes with complete assurance that it'll produce a usuable extrusion the first time it is tried. That's because the die designer has to juggle many different variables. He must consider characteristics of the alloy to be extruded. He must make allowances for stress and

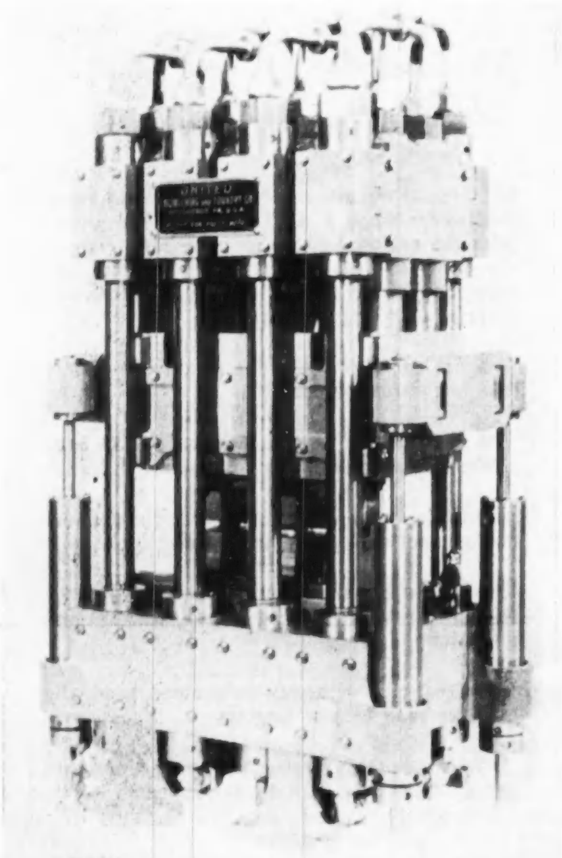


Fig. 6—Gigantic proportions of forging presses on the U. S. Air Force heavy press program are graphically illustrated by this model of United's 35,000-ton machine. The press will tower 70 ft high and weigh some 10,000,000 lb

distortion, thermal contraction of the piece following extrusion, and reduction in thickness on stretching. And above all he must get balanced flow of metal through all parts of the die opening.

It's difficult to fill the thin extending protrusions attached to the heavy body of an extrusion. Metal finds it easier to go through the large, center portion of the die opening. And as ingots and sections become larger, variations in flow characteristics increase.

Thus, with the advent of larger extrusion presses, die designers are going to have to make even greater use of the ways of compensating for nonuniform flow. These include varying the arrangement of the opening on the die face, providing wider openings for thin portions of the extrusion, and adjusting bearing length in various parts of the die.

Fortunately, enough is known about die building so that it is rarely necessary to construct a new die to make the required alteration. But because tool costs are high for large presses, extreme care will have to be exercised in the use of dies. Adequate backup tools will be needed to prevent excessive die breakage.

What's Worrying Press Operators

Limited experience with large presses points up production problems forgers will run into when they start operating the really big fellows. Some of these difficulties forging producers believe they can control or improve. Others, they feel, can best be solved by substantial assistance from customers and ingot suppliers.

For example, they will be able to partially satisfy the desire of aircraft designers for forgings which require a minimum of machining. This means less draft, thinner webs, smaller fillets and radii, and closer tolerances. The extent to which they can do this though represents a compromise between requirements of the customer and the most practical forging methods available.

Fig. 7—One of the first dies used on Wyman-Gordon's 18,000-ton forging press. It's small compared to dies now used on the same press (see Fig. 8)

Fig. 8—Huge dies now used on Wyman-Gordon's 18,000-ton forging press. Dies for the monster forging presses in the works will be even bigger, more complicated . . . . and more ticklish to make

Press operators also figure that they can design tools and choose processing methods that will permit them to take best advantage of known stock characteristics. But what they'd really like is forging stock that would give good, usable extrusions no matter how it is pushed around.

Friction between die and forging is another thorn in the sides of forgers. Not only does this friction have a tremendous influence on forging pressures required, but it also can prevent metal from completely filling the die cavity. New lubricants are helping forgers out of these troubles, but there's still room for improvement.

Extrusion press operators also have their share of problems. For example, they're faced with a search for ways to speed up the rate at which large extrusions can be turned out. If an extrusion is pushed through a die too quickly, tensile stresses set up in the outer fibers exceed the strength of the metal and cause rupture. And the bigger the die opening and the more alloying constitutents in the metal being extruded, the more likely this is to happen. Obviously, then, the large-section, high-strength aluminum alloy extrusions the Air Force needs will present special problems.

One way press men expect to increase production rate of these parts is to water cool the extrusion die. Removing heat in this way made it possible to push larger extrusions of 75S alloy through a die 30 to 100% faster.

Bigger Auxiliary Equipment A Must

To get the utmost out of their huge presses, forgers and extruders are also going to need bigger auxiliary equipment. Preheat and reheat furnaces big enough to handle large ingots, heat-treat furnaces that can take long extrusions, and more powerful straightening machines are musts on their lists.

Preheating, especially, is going to assume greater importance with the new order of ingots. That's because the bigger the billet, the more preliminary heat-treatment it takes to get the hunk of metal ready for hot working.

Machines for straightening extrusions have an equally important role. But the largest stretcher now available can exert a pull of only 750,000 lb, enough to handle a 75S extrusion with a cross-sectional area of 15 sq in. Press operators are going to need more stretchers like the one being built for the 13,200-ton extrusion press. With its pull of 3,000,000 lb, this strecher will be able to straighten 75S extrusions of 60 sq in. cross-sectional area.

Atomic Power . . .

. . . is vital to the free world. The demand for energy is growing fast and cannot be satisfied indefinitely with conventional sources of power.

Based on paper by **Edwin J. Putzell, Jr.** Monsanto Chemical Co

OUR high standard of living is part and parcel of our tremendous energy consumption, and, according to the Paley Commission, we shall need twice as much fuel and electricity by 1975 as we used in 1950. This is going to put a heavy burden on our limited fuel and waterpower resources.

No matter how large our petroleum resources prove to be, this resource is dwindling and will become progressively inadequate. Demand has already begun to outstrip domestic production to make us an importer. What deposits of oil and gas we have left are being exploited at ever increasing cost. Waterpower, too, is limited. Only a few large sites for low cost power remain to be developed and the less desirable sites mean higher capital outlay per unit of output and other expenses to be able to deliver current at the same low cost. Add to this the fact of increasing costs in coal mining despite greater productivity and it becomes obvious that electricity cannot meet the needs of 1975.

In our judgment, atomic power is both an end in itself and the means to other ends equally important. It will make possible better use of dwindling natural resources. Adding uranium and thorium to our fuel inventory will permit the use of more oil and gas where they have unique value.

The task of designing, building and perfecting atomic engines for practical non-military use presents one of the great industrial challenges to this generation. Nuclear-created electric power can function as a tool of international diplomacy, a tool this country can use in its opposition to totalitarianism. If such a project can be so useful in producing energy for the United States where energy resources are relatively abundant, think what it can do for our friends abroad whose resources are expensive or even inadequate. Many countries could better develop their resources and industries if they had cheap energy and thus improve the lot of their people.

We Americans have talked expansively about spreading the advantages of our know-how and technology throughout the world to improve economic and social well-being. In this new energy-producing tool, atomic fission, we have a means to accomplish this goal. In a world full of doubt, despair and recrimination, this new tool of mankind, with its promise of cheap energy, will give the free world a new lease on life. (Paper, "Atomic Power—Is It Necessary?", was presented at SAE National Diesel Engine Meeting, St. Louis, Oct. 30, 1952. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers.)

AUTOMATION is the Keynote

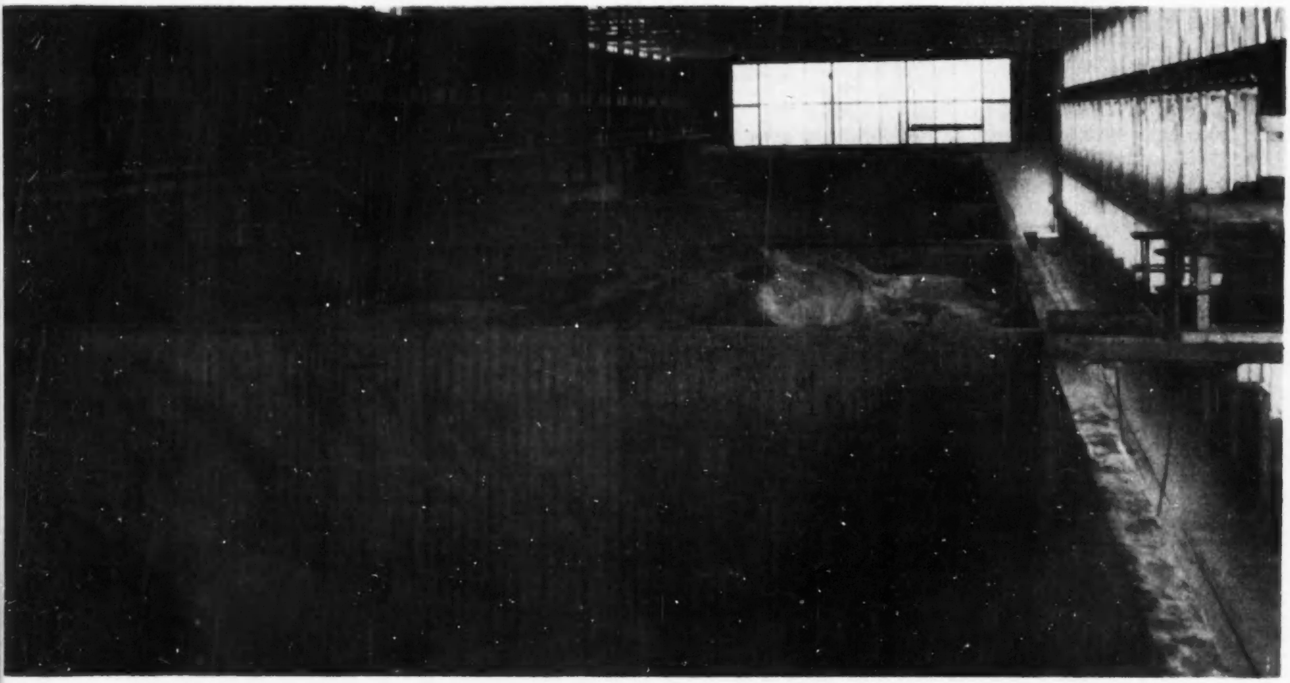
in Ford's Cleveland

FORD'S Cleveland foundry and engine plant are among the most modern in the world. That's what participants in the SAE National Production Meeting found when they visited these facilities on March 27.

Gray iron at the foundry is cast into cylinder blocks, heads, and miscellaneous castings. They are then transferred to the engine plant where they're machined, assembled into completed engines, tested, and shipped to various assembly plants throughout the country ready to power a car or truck. The machinery and equipment that transform this raw iron into finished engines in this less-than-two-year-old facility are among the most modern available.

Automatic devices are the rule throughout

Casting the



SAND is one of the materials for which the Ford foundry has an omnivorous appetite. Both core sand and mold sand are brought from dryer-coolers by belt conveyor (along left wall) to these bins and stored there

Foundry and Engine Plant

both plants . . . from sand handling in the foundry to the automation of machining lines in the engine plant. Automation achieves at least three things, says Ford:

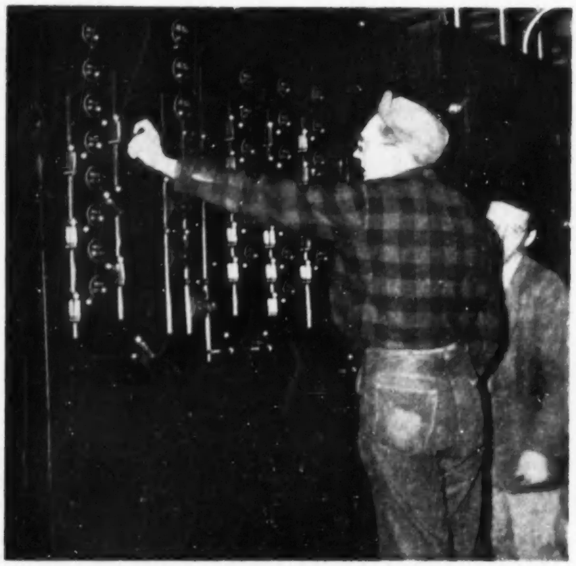
- It saves time.
- It saves manpower.
- It improves quality by cutting down the chance for error.

Right now the engine plant and foundry are producing Ford 6-cyl engines. However, plans are now being made to produce the '54 Mercury engine. The engine plant can turn out 144 6-cyl engines per hr. The foundry can pour 25 tons of iron per hour.

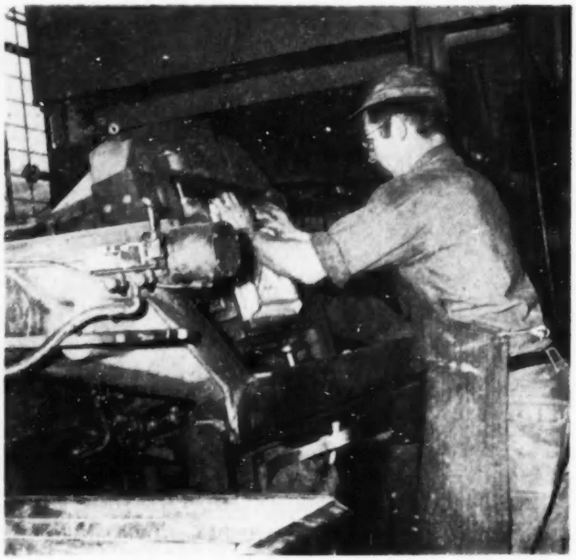
Shown below are some of the highpoints in both plants seen by the SAE group.

Engine Block

IRON also is consumed in large quantities. The pigs, steel scrap, and sprues are stored in this area. From here the iron, in carefully measured proportions, is carried to the cupolas



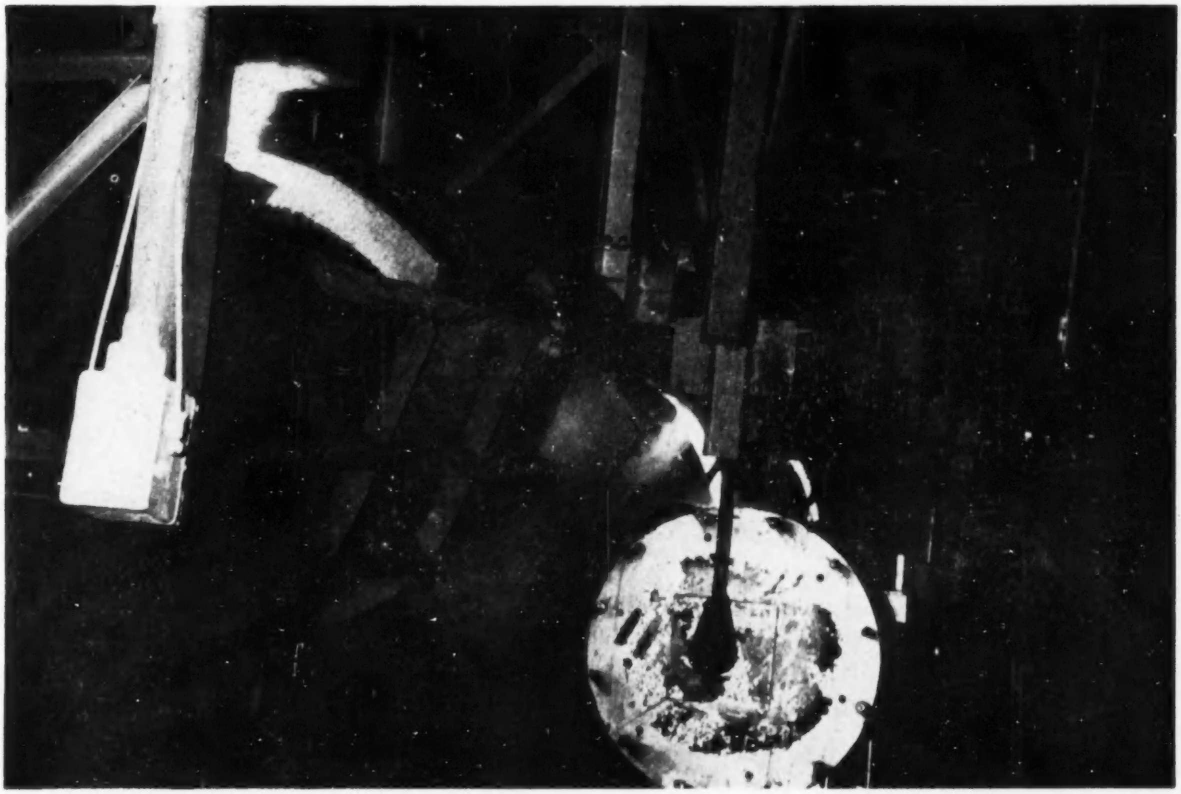
1. A flip of switch directs sand pneumatically from sand preparation center to any one of 37 receiving hoppers in the core room



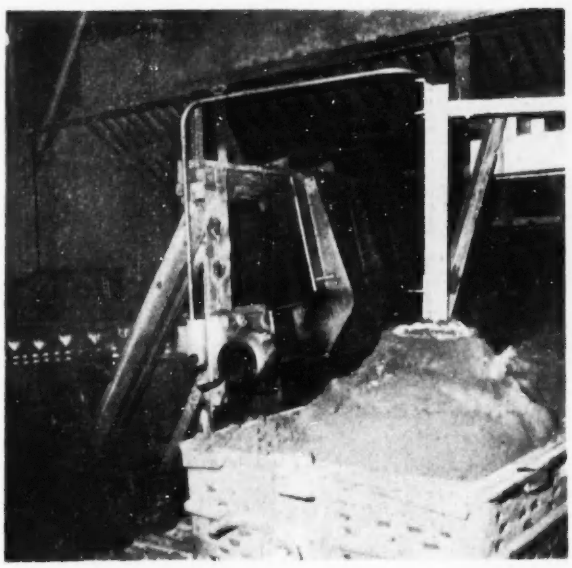
2. Into a machine goes the sand and out comes a core for a pair of cylinders. Shown is rollover-draw operation on crankcase core

3. Conveyor dips cores into tank for a coating that'll give cores tough skin

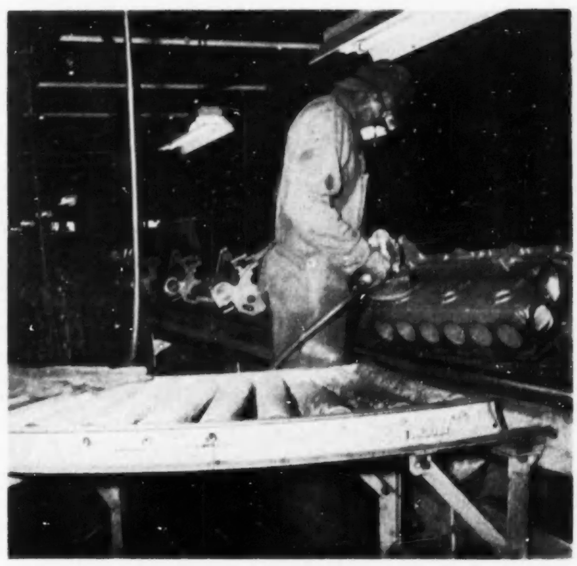
4. Special handling device makes it easy to lower core assembly into drag mold



5. Hot metal is poured from the cupola into the forehearth (top) and from the forehearth into a hot metal carrier ladle (center). The Ford foundry has 10 cupolas and one electric furnace

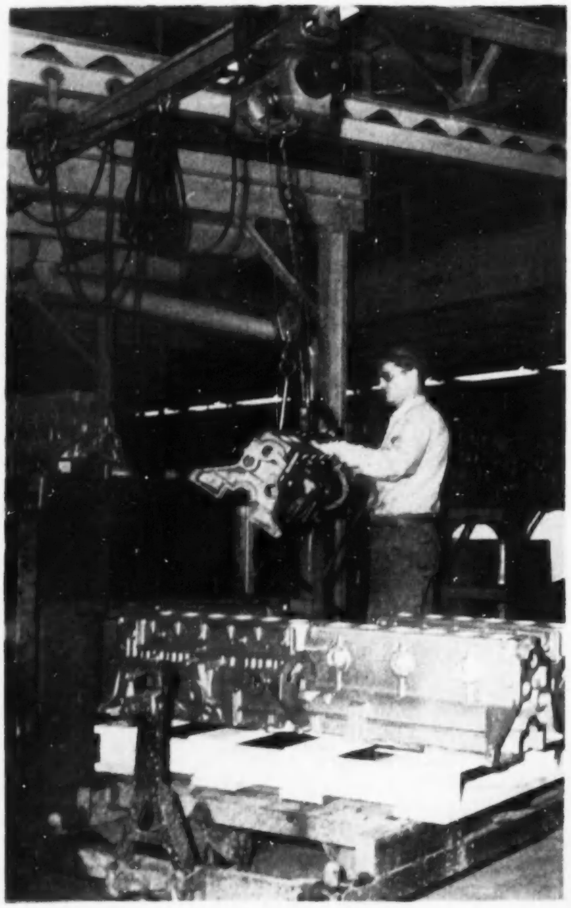


6. After the molten iron is poured into the mold, the cope is removed and the casting allowed to slow cool in the sand before being shaken out

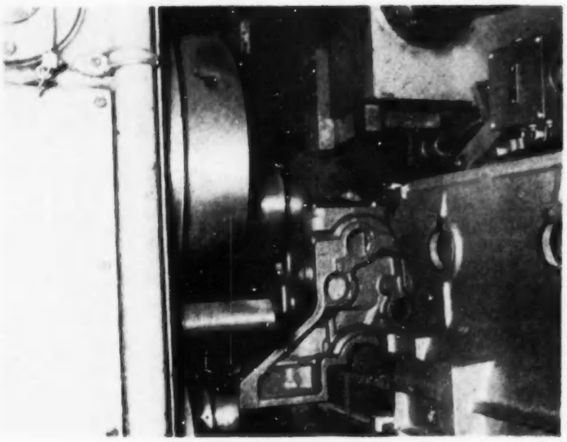


7. Several grinding operations are performed on the casting to remove fins. The casting is then shot blasted

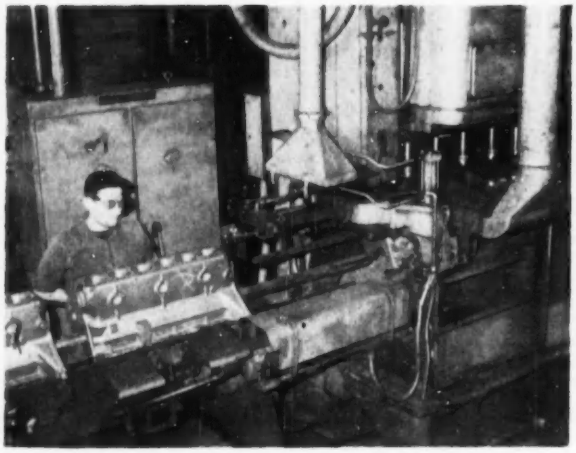
Machining



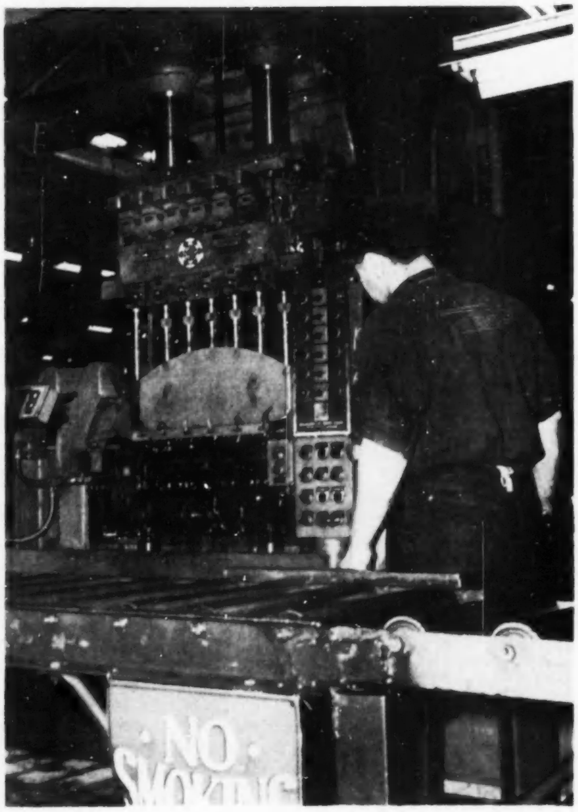
8. Blocks received from the foundry are placed on the automation machining line in the engine plant



9. One of the first operations in the automatic setup is to machine the locating spots

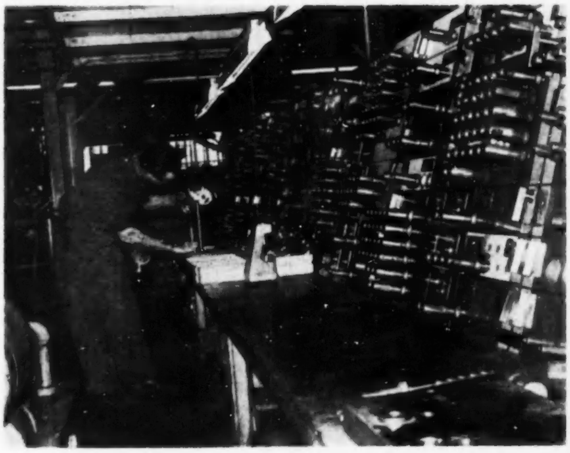


10. A maintenance man checks to see that all is well as block emerges from rough boring operation

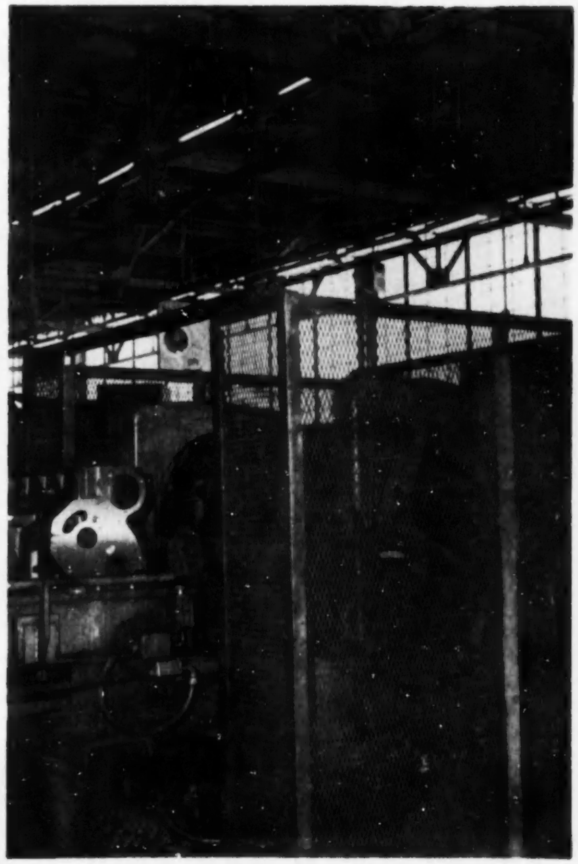


11. Machine automatically hones all six cylinders at once to size. It takes about 17 strokes

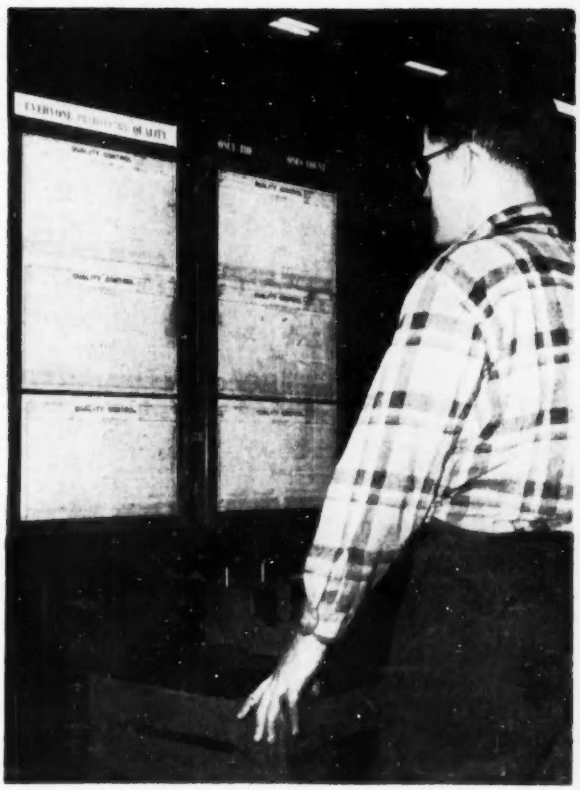
the Block



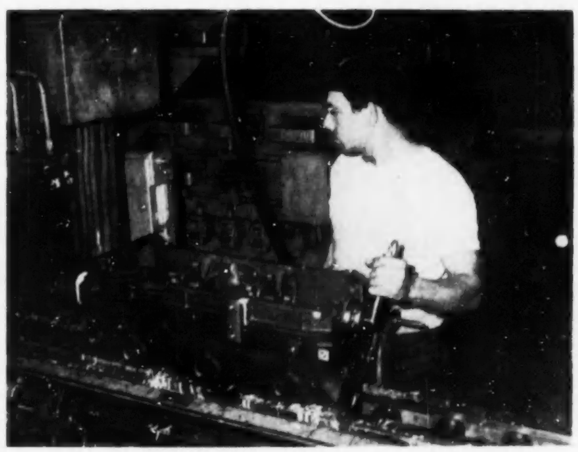
12. Tools are replaced when their estimated life is up. This board has 197 for a Cross transfer machine



13. One of the automatic handling devices is this turntable which inverts block and turns it 90 deg

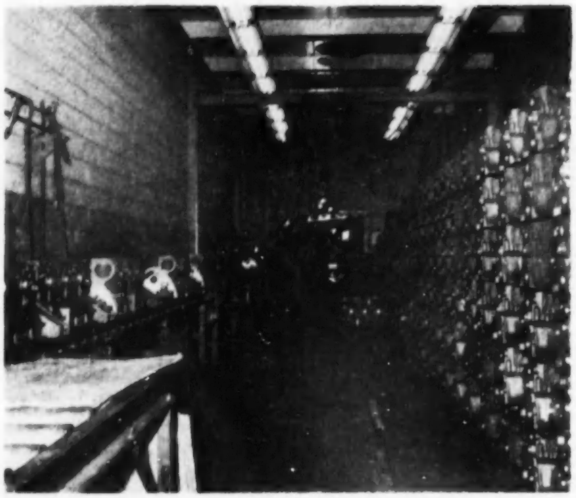


14. Statistical quality control is maintained on the machining line, these charts show



15. Typical of the inspection operations is this check of the crank bore with an air gage

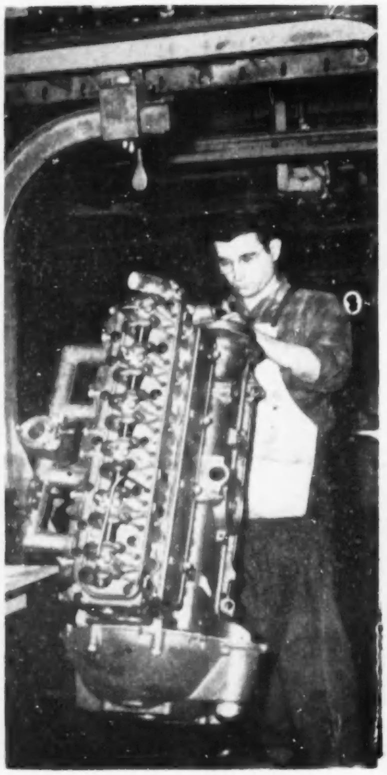
Assembling and Testing



16. Engines are graded for bore size prior to assembly. Pistons in three sizes are matched to them

17. One of the first assembly operations is to lower the crankshaft into the block

18. Pistons are inserted . . .

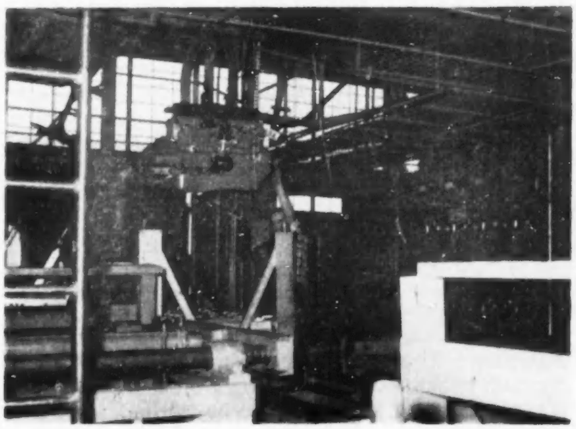


19. . . . and pulley wheel for fan belt is assembled . . .

20. . . . and tappets get adjusted

the Engine

21. This "doctor of motors" listens for strange knocks as the completed engine is put through a run-in test. Engines also are checked for oil pressure and oil, water, and gasoline leaks



22. Engines tagged O.K. are crated in a steel rack, five engines to a rack . . .

23. . . . and stacked in a freight car headed for assembly plants to go into Ford cars

Production Problems

OPERATIONS RESEARCH applies the methods of scientific research to problems arising in use of equipment and controls—in the light of the surrounding production and management aims.

An "operation research" attack is simply an unbiased, systematic approach. It is essentially the approach of the scientific method.

"Operations research" began when groups of scientists got to analyzing combat data in World War II. They were trying to rate the effectiveness of this military operation or of that weapon. And, being scientists, they applied the scientific method.

Faced with the problem of finding enemy submarines at sea, for example, mathematicians, physiologists, electronic engineers, and other scientists in the group combined their application of the scientific approach to get a right answer.

The mathematicians isolated and measured from combat records the effects of searcher speed and altitude and meteorological conditions on the probability that a submarine would be sighted. . . . Physiologists contributed factors for the behavior of the eye. . . . Electronic engineers provided data on radar behavior. . . . And all this was worked into a theory of the search operation, which helped decide allocation of searching effort and choice of equipment.

Since then, business has used operations research to guide management decisions on production, inventories, sales, feasibility of proposed products, and other problems. In business, the operations research team usually consists of a mathematician, a physical scientist, and a business-administration expert.

It's not that operations research teams know more about war than military men do—or more about business than businessmen do. But an operations research team can formulate military and business problems in a new language.

Here's how operations research—or O.R. as businessmen call it—works:

1. The O.R. team selects measures of effectiveness for judging the success or failure of an operation.

2. The team develops a working model of the operation to be studied. This model usually is a set of mathematical expressions. It must be usable to predict quantitatively the effects of alternative courses of action.

The mathematical model is manipulated by techniques beyond those normally used in engineering—such as communications theory, game theory, linear programming, or variational calculus—as well as probability and statistical theory.

3. The model is checked against operating or experimental data reflecting varying conditions. It's satisfactory if it reproduces actual results when such factors as time, place, or type of product are varied. If need be, the model is adjusted.

4. The model is used to determine the optimum levels at which the operation should be carried out, predict the effects of alternatives, and devise simple rules or control charts for operating personnel to apply.

Four examples of the O.R. attack on production and management problems follow:

Example—Production and Inventory Scheduling

Problem: A manufacturer needed to know how to schedule production and inventories to meet seasonal sales at minimum overall cost.

Existing policy was to schedule production relatively uniformly throughout the year to meet the sales forecast with a minimum of overtime and alteration of labor force. Inventories took up the slack.

This suited the production manager. The sales manager was satisfied too, as long as inventories were always large enough so that he could meet demand. But the treasurer thought that the uniform production rate involved unnecessary storage costs and tied up funds in too large inventories.

Scheduling was difficult because of the large number of products and production lines. And several factors involved could only be argued about.

Measure: Total of costs associated with the schedule became the O.R. team's measure of effectiveness. It was, of course, to be minimized.

Model: The model was a mathematical expression totaling the separate sums of the costs as-

PRODUCTION TOMORROW

Bow to Operations Research

John B. Lathrop, Arthur D. Little, Inc.

Based on paper "Operations Research as Applied to Industrial Production and Development" presented at SAE National Production Meeting, Cleveland, March 26, 1953. Complete paper is available in multilithographed form from SAE Special Publications Department at 25¢ a copy to SAE members and 50¢ to nonmembers.

sociated with production, inventorying, and back orders—each group representing the interests of one of the executives. Severely summarized, it looked like this:

$$\text{Cost} = \Sigma C_P(P_m) + \Sigma C_I(I_m) + \Sigma C_{BO}(I_m)$$

where:

$C_P(P_m)$ = Cost of producing in any month an amount P_m

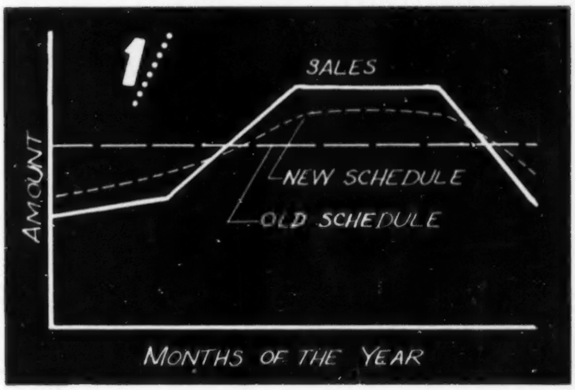
$C_I(I_m)$ = Cost of carrying in inventory an amount I_m

$C_{BO}(I_m)$ = Cost of back orders associated with an amount of inventory I_m

The best schedule can be solved for by the technique of linear programming, an arithmetic for solving such equations. (The "best" schedule does, naturally, have to conform to company policies such as those relating to overtime and can not exceed capacities to produce or store.)

Important features of this O.R. model were the limiting of costs to those related to the production schedule. For instance, the cost of raw materials had to be borne sometime during the year. So it was essentially unaffected by the production schedule, and was not represented in the model. On the other hand, costs of overtime production had to include costs of setting up extra shifts and any increased costs due to less efficient labor and supervision. Overtime costs had to show up in the model.

Back-order costs, except for those due to extra handling and bookkeeping, had not been measured before. Although it was difficult to cost loss of customers and good will, solving the model against previous production schedules revealed the values



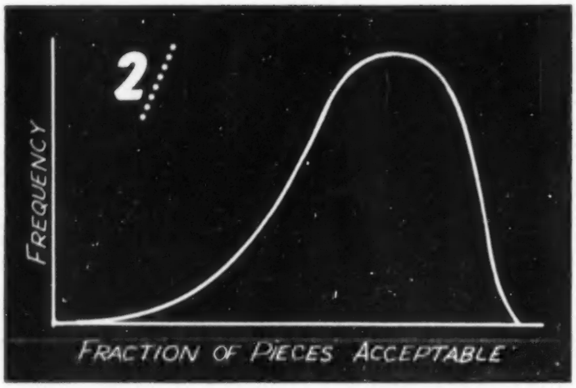
unconsciously assigned to back orders in practice. The O.R. team developed graphical methods to show the effect of the choice of back-order costs on minimum inventory levels and carrying costs.

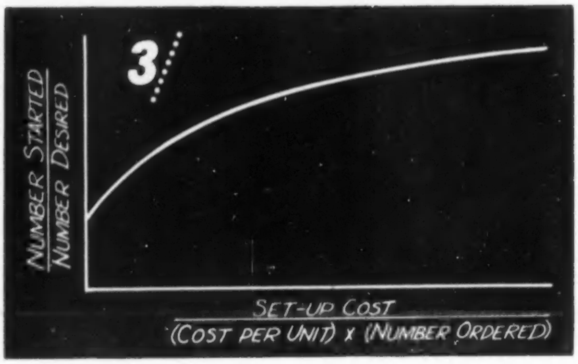
Results: For the O.R.-developed schedule, (Fig. 1), overtime plus inventory costs turned out to be only 44% of those for the schedule previously planned. A quick and simple method for extending the optimum scheduling to all production divisions of the company was devised. So were methods for altering schedules with changes in costs. Guesswork in scheduling was eliminated. And arguments dissolved into discussions concerning the values of component factors, with knowledge as to how variation in any of them should affect overall costs.

Turn page for more

Example—Planning Machine Runs

Problem: A subcontractor had to figure the number of pieces to produce on any one order. His spoilage varied widely from run to run of the machines. Customers normally would accept up to 10% overrun. But if larger numbers of pieces were made, the excess could only be scrapped. Yet if spoilage was high and too few pieces were made, the subcontractor had to set up the machines again and rerun—an expensive process.





Measure: Since the production manager wished to maximize gross profit, this was the measure of effectiveness the O.R. team used. They developed a mathematical expression of the measure (appearing below) in terms of the model.

Model: When the O.R. team plotted production data (Fig. 2), they found that the equation

$$\phi(x) = kx^{a-1}(1-x)^{b-1}$$

fitted the curve of finished output as a function of started quantity.

Here x = Fraction of started quantity which was acceptable
$\phi(x)$ = Relative frequency of runs producing an acceptable fraction x
k, a, b = Constants to be solved for

The mathematical expression derived from this for the measure of effectiveness was:

$$P = P' - s\int_0^{A/S}\phi(x)\,dx - cs\int_{1.1A/S}^{1}(x - 1.1A/S)\,\phi(x)\,dx$$

In this equation,

P = Gross profit
P' = Gross profit if just the right number of units is made
A = Number of pieces started
s = Cost of an additional machine setup
c = Cost per unit produced

Maximizing the expression for profit yielded a curve such as Fig. 3.

Results: Now the subcontractor can read off from charts like Fig. 3 how many units to produce for a given order, according to the size of the order, the unit cost, and the setup cost.

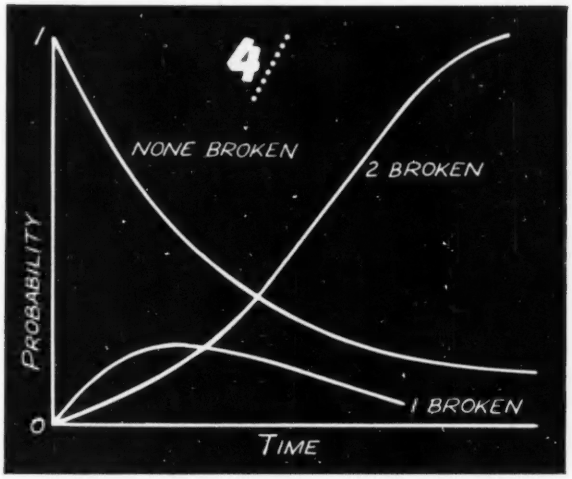
Example—Determination of Inspection Intervals

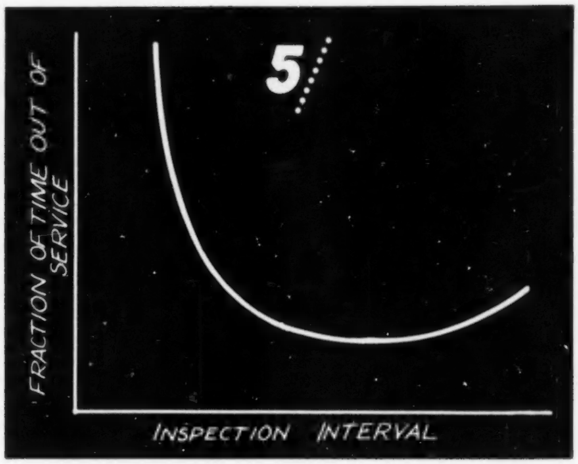
Problem: A manufacturer faced the problem of deciding whether or not to institute a program of regular inspections of two bolts in a certain machine—and, if so, the inspection interval.

The two bolts secure a bearing in the machine. If one of these bolts is intact, the machine will operate. If both break, however, the machine is down for 20 hr for repair and adjustment. Inspection of the bolts while the machine is still in running order—with or without replacement of the bolts—takes the machine out of operation for 2 hr.

Measure: Expected fraction of time that the machine is out of service—which is to be minimized—became the measure of effectiveness.

Model: The O.R. team developed the mathematical model from operating data and probability theory. The data showed that bolt life averages





1000 operating hours, provided that both bolts are intact and sharing the load. After one bolt is broken, average life of the remaining bolt is 200 hr. Bolt breaks appear to occur at random, so that the distribution of bolt lifetimes is exponential.

The model took the form of the probabilities that none, one, or two of the bolts will be broken after a machine has been operated for any given number of hours after an inspection. Fig. 4 shows the probabilities.

Extension of this model to include the times required for inspection or repair related the fraction of time that a machine could be expected to be out of service with any given inspection interval. Fig. 5 shows the form of this relationship.

The formula for this "decision function" is

$$f = \frac{20 - 30e^{-t/500} + 12e^{-t/200}}{720 - \frac{2590}{3}e^{-t/500} + \frac{436}{3}e^{-t/200}}$$

Result: The manufacturer could tell from prepared charts that regular inspections would pay off—and how frequent they should be.

Example—Evaluation of a New Development

Problem: In connection with the development of a proposed transportation control equipment, a company wanted to know how much the equipment would improve the operation. The technical characteristics, costs, and reliabilities of the proposed equipment and those which it might replace were well known. There was no good way, however, to place it in an operational rather than a technical environment, and there to compare it quantitatively with competing equipment.

Measure: A "passing parameter" was developed. This was merely:

$$P_o = \frac{T_1 - T_2}{t}$$

where T_1 and T_2 were the times at which trains were scheduled to arrive at a possible point of conflict—such as a siding on a single track road—and t was the time it would take the faster or heavier train to decelerate and stop.

The measure of effectiveness chosen to compare alternative control systems was total train delay per day due to control.

Model: A working model for a typical actual stretch of road was developed in terms of the speeds, accelerations, and densities of trains during a typical operating day, and the number of meeting points involved.

Results: On the basis of the O.R. analysis, the company discovered that its proposed control was not enough better than existing equipment to justify its development. The company saved the expense of a research program on a product that almost certainly would not pay off.

How Atomic Energy

OUT of the vast amount of publicity that has been given to atomic energy has come great speculation concerning possible peacetime uses and benefits of this relatively new discovery. Much of the speculation has been misleading and confusing and, in some instances, provocative of fear that sudden new developments might quickly outmode today's conventional installations and thus destroy existing capital investment.

It is well, therefore, to base our thoughts regarding the future possibilities upon practical and economic considerations and to view the situation in the light of experience with earlier discoveries that, in their day, were just as spectacular as atomic energy is today.

At present, one of the most promising peacetime uses of this newly available source of energy seems to be its industrial applications as a source of heat energy. The benefits which atomic energy development may ultimately bring to us will depend upon our ability to utilize it in a manner that will give greater overall economy than our use of other energy sources now available to us.

As of today, large-scale industrial use seems to be in the direction of the production of steam for both electric power generation and for industrial heating and processing, and also for ship propulsion. Other uses may be possible, but they now would seem to be in the more distant future.

Over a period of more than half a century the automotive industry has developed remarkable motor vehicles, which have substantially changed many phases of our life. Yet we still look forward to even better automobiles. The benefits of nuclear energy will be realized in the same way, slowly, through application of ingenuity, but mostly as a result of constant hard work and perseverance.

Atomic energy, through its application to the generation of electric power and to other industrial heat processes, may influence our lives radically but perhaps by imperceptible stages extending over a prolonged period of time.

Nuclear Reactors

Through the efforts of the Atomic Energy Commission and its predecessors, machines known as nuclear reactors have been devised for converting the energy of nuclear fission into forms which can be put to useful purposes. Many different kinds of reactors have been built and proposed, the designs being dependent upon the intended use and a wide variety of technical considerations. Although there is reasonable agreement as to the theory that is involved, there is no general agreement concerning the most appropriate design, the most desirable type or form of the fissionable material that should be used as the fuel, and innumerable other problems.

This is the real crux of the problem today. We have the theory of nuclear fission well developed and we have fissionable materials available. But we do not have reactors nor reactor designs that are considered appropriate or acceptable for large-scale peacetime commercial uses. Present studies are directed toward providing more information on these questions.

DOW-EDISON PROJECT

For nearly two years, the Dow Chemical Co. and the Detroit Edison Co. have been engaged jointly under a contract with the Atomic Energy Commission in studying the possibility of using the heat of nuclear fission in industry.

Within the past few months a number of additional companies have become associated with this project. The group as now constituted includes both large and small electric power systems, together with industrial manufacturing and engineering organizations, two of which are prominent automotive companies. It thus provides the broadest management, engineering, and technical background and experience, which are all needed to solve one of the most complicated problems of our times.

It should be said also that at least four other industrial groups are working on this same problem and that the work of the Atomic Energy Commission and its staff in the Commission's national laboratories continues. Great efforts indeed are being exerted to keep our country in the forefront in this development, bearing in mind, however, that it would be unwise and uneconomic to pay an excess price for such power.

The work on the Dow-Edison project has proceeded on the basis that the commercial use of atomic energy for the generation of electric power can be justified only when the cost of heat energy from nuclear fission is competitive with the cost of heat energy from conventional fuels. In other

PRODUCTION TOMORROW

Can Serve Industry

Walker L. Cisler, President, Detroit Edison Co.

Excerpts from paper, "Future of Atomic Energy in Industry," presented at SAE Annual Meeting, Detroit, Jan. 13, 1953.

words, the cost of the electric power produced using atomic fuels must be equal to or less than the cost of power produced by conventional sources of energy, such as coal, oil, and gas.

This is a reasonable stipulation. Electric power users should not be expected to pay more for electricity simply because it is produced by atomic fuels. A kilowatt-hour represents 3412 Btu to the consumer regardless of how it is produced.

After nearly two years' study on the project, definite progress is being made and some basic conclusions have been reached. The radiation that is produced can be converted into electricity, but this represents only a small part of the total energy released when the atom is split. Beyond that, scientists have found no practical way in which atomic energy can be converted directly into electricity. Nearly all of the energy released during nuclear fission is kinetic energy, which is immediately converted into heat, and heat is a type of energy with which we have dealt for years.

Atomic energy when applied to the generation of electric power would simply furnish the heat needed to produce steam and operate steam-turbine generators. Reactors burning fissionable materials as a fuel would, with appropriate accessories, take the

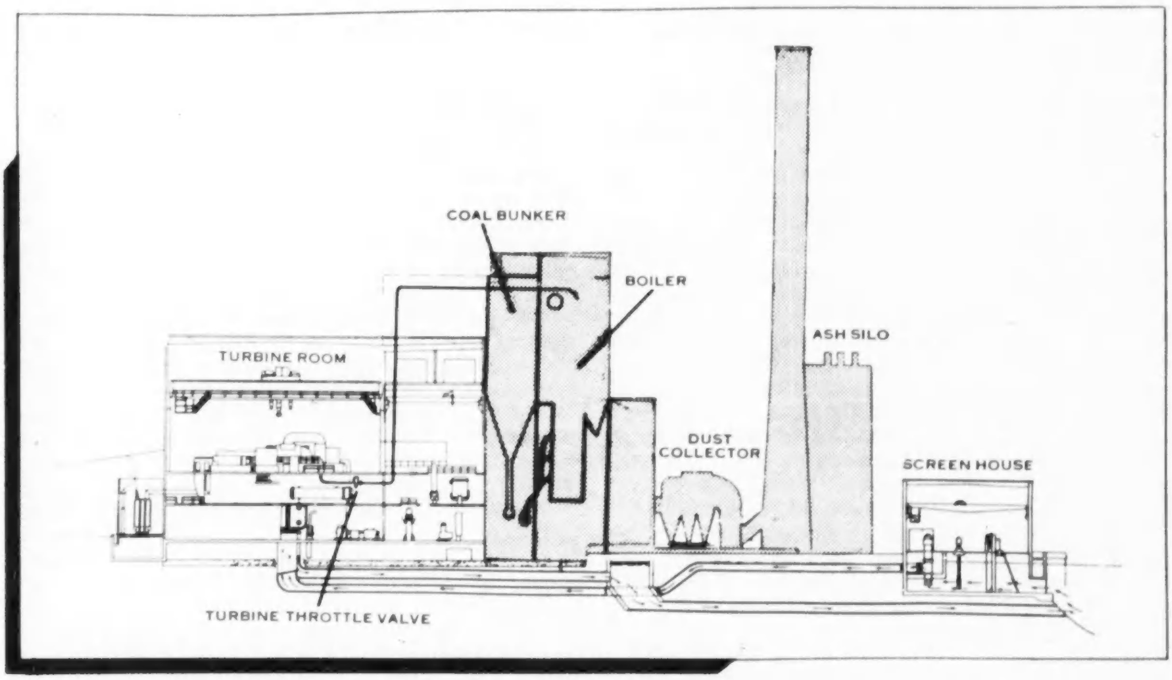


Fig. 1—Cross-section of new St. Clair thermal-electric power plant of Detroit Edison Co. Shaded area might be replaced by nuclear heat power reactors

place of the boilers and appurtenances of the present conventional thermal-electric power-generating plants. The electric generating part of the conventional steam-electric generating station, containing the steam-turbine generators and other related equipment, would be retained essentially in its present form if atomic fuels are used instead of present fuels. The shaded portion of Fig. 1 shows the part of the plant for which nuclear reactors may be substituted. Fig. 2 is our present conception of how the new St. Clair power plant might look if reactors rather than coal-fired boilers were used to produce the heat.

The theory of the reactor—the device in which the atom is split or fissioned and the heat is released—is well advanced. Extremely large amounts of heat would be released in a very small volume and transferred at a high rate per unit of heat exchange area.

At the present time, a breeder reactor, which will produce more fissionable material than it consumes, appears to be the most fitting for the generation of electric power on a widespread basis. The breeder process, however, is not in the category of perpetual motion schemes.

How Reactor Works

In a breeder reactor, the core or critical mass contains fissionable materials, which may be either uranium 235 or plutonium 239. The atoms of these fissionable materials in the core are fissioned to produce heat as required and simultaneously the neutrons that are liberated during the process convert atoms of natural uranium 238, which is not fissionable, into plutonium 239, which is fissionable. The physics of the reaction are such that more plutonium, or fissionable material, is created than is consumed. This manmade fissionable material can be isolated or separated and used in the core as the fuel to produce more heat and more plutonium. The surplus plutonium can be made available for other requirements. This same cycle is possible with thorium and uranium 233.

In this process, then, the fuel after the initial charge would be natural uranium or partially depleted uranium, and it is believed there are adequate resources of these materials to provide heat energy for the generation of a large part of the world's electric power requirements for hundreds of years. Dr. Walter H. Zinn, director of Argonne National Laboratory of the Atomic Energy Commission, has indicated that the cost of natural uranium may be approximately $35 per pound, and one pound, when completely used in a breeder reactor, has the heat equivalent of approximately 1300 tons of coal. On this premise the cost of the heat units from these materials would be negligible in the total cost of generating electric power.

Because of the pioneering work done by the Argonne National Laboratory with the experimental breeder reactor, it now seems possible to build a breeder reactor of commercial size, together with the necessary accessories, which could be used to produce steam for the generation of electric power. No reactor practical for commercial application has been fully designed or built, and a vast amount of research and development is necessary before such a reactor can be an actuality.

In the Dow-Edison project a high-temperature breeder reactor, together with an integrated reprocessing scheme, was the choice believed most promising for use in the generation of electric power. This proposed reactor system is now the subject of detailed technical study, and represents an exceedingly difficult task. The problems to be solved before such a reactor can become a commercial reality involve the coolant system needed to recover the heat released in the reactor, the processing and reprocessing of the fuel, the processing of the fissionable material produced by the reactor, and the manner in which numerous chemical and metallurgical requirements can be met.

The first phase of the Dow-Edison project, which consisted of a thorough review of all available data concerning the possible utilization in industry of the heat from nuclear fission, was completed in 1951. The second phase of the project, which consists of a preliminary design of a reactor believed appropriate for commercial application, is progressing in an encouraging manner.

There are many compelling reasons, having to do with our national security and our economic position among the nations of the world, for carrying this development forward as rapidly as possible. We should continue to press this research forward in our national laboratories, and we should bring into the effort the full strength and ability of our industrial system. We can be sure that other countries, less favorably endowed with energy resources than ourselves, will make a supreme effort in this direction

The present manner in which our country is attempting to solve the technical problems is encouraging. The Atomic Energy Commission and our national laboratories are fulfilling their responsibilities aggressively and with wisdom. Private industries—chemical, electric power, manufacturing, and engineering—are entering into the field in increasing numbers.

Because of the intensity with which the use of atomic fuels for electric power generation is being studied, it is reasonable to expect rapid steps forward. The fact that designs for atomic-powered submarines are well advanced is certainly strong evidence that the use of these fuels is possible so long as cost is not the first consideration.

We can expect that experimental electric power-generating installations will progress along with these military developments. The time when electric power from atomic fuels may become available on a commercial basis is uncertain. Many of those examining the situation objectively believe that some practical results may appear in five to ten years.

There is no evidence that the first installations can be built at costs which will make the power produced competitive with present-day conventional generating methods, but, based upon the small physical size of reactors as compared with conventional fuel-fired boilers, and other engineering considerations, the cost problem does not appear insurmountable. It is believed that, after initial experience in reactor design and construction is gained, this goal may be reached for units

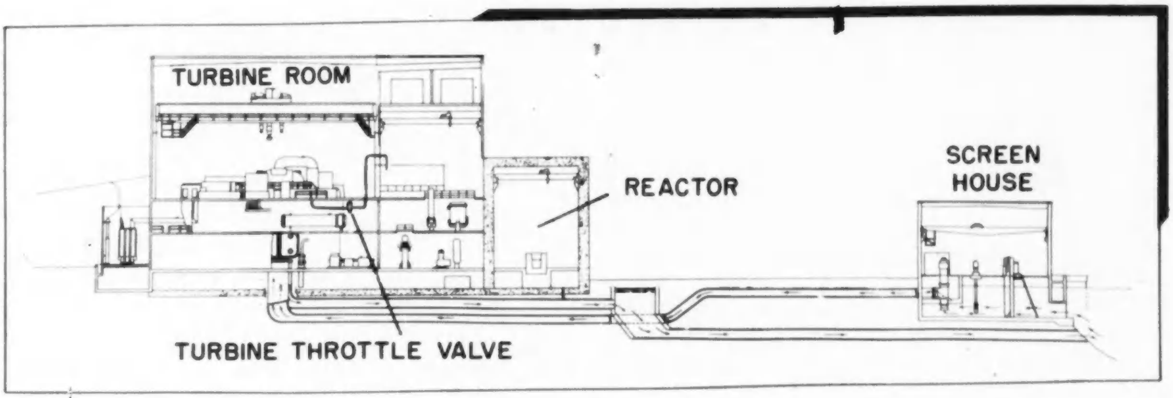


Fig. 2—Present conception of how St. Clair power plant might look if nuclear heat power reactors were substituted for coal-fired boilers

having large thermal and electrical capacities.

It is unlikely that electric power generated by atomic fuels will greatly influence the cost of electricity to the consumer. Atomic-fueled reactors would take the place of coal-, gas-, or oil-fired boilers—and these boilers represent only 17 to 20% of the total investment in a typical electric power system. The remainder of the system would be unchanged. The increased investment required for reactors as compared with fuel-fired boilers would largely offset the saving in fuel costs. The major expense of operating a power system very probably cannot be substantially altered by this substitution for many years at least.

Reactor products and byproducts may hold the key to the competitive cost problems in the production of electric power. If these have great value—and the reactor is given proper credit—then the cost of electricity might be lower than now envisaged. For the present, however, we must assume that the value of reactor products will be modest and base our studies largely on the competitive value of the available heat energy in the atomic fuel.

LEGAL PROBLEMS

One of the most important problems involved in the development of peacetime uses of atomic energy is the matter of ownership of materials and facilities. The Atomic Energy Act of 1946 (familiarly called the McMahon Act) provides that only the government may own fissionable materials and facilities for the production and utilization of fissionable materials. All of the development work of the past ten years has been carried out by the government, first under the Army's "Manhattan Engineer District" and since 1946 by the Atomic Energy Commission. The main effort was first directed toward meeting the military needs of the country, but in recent years much attention has been devoted to nonmilitary considerations.

Because of the ownership stipulations of the Atomic Energy Act, and the need for maintaining strong security provisions, private industry has not had the opportunity to participate in the development on a competitive enterprise basis as it has in other great developments of the past.

The growth and strength of our country has been brought about by privately owned indusutry and private investment. Through the efforts of private industry, our resources have been developed and put to use. Private industry has been able to profit from its efforts and investments, and these have provided the incentives to experiment, to assume risks, and to create new and more desirable products of many kinds.

Law a Barrier

Under the atomic energy law as it now stands, it is impossible, through private investment, to construct, own, and operate a reactor that would produce the heat for electric power generation. Similarly, it is impossible for an automobile manufacturing company—or any other privately owned industry—to own fissionable materials, or facilities for using those materials, which might be useful in their operations. There has been little participation of industry in the development, except as contractors to the Commission.

Without the full participation of industry, the atomic energy development cannot move forward rapidly and on a broad front. There is great need, therefore, for Congress to reconsider and modify the terms of the present legislation. If this is done, industry will respond as it has so many times in the past when new developments offered new opportunities.

The approach of the Dow Chemical Co. and the Detroit Edison Co. and associates in their joint

project always has been that of private industry. They are proceeding with the second phase of their project as rapidly as possible. If the technical problems can be resolved, the two companies would like, as soon as possible, to build and operate a reactor plant of commercial size—using private capital and without recourse to government funds, guaranteed prices for reactor products, or subsidies of any kind.

As for the future, if a flourishing private enterprise can be achieved in the atomic energy development, an additional advantage would be gained. This enterprise would be adaptable to the production and utilization of fissionable materials required for both peacetime and military uses. Our country's strength would then be measured, not by the production capabilities of a governmental arsenal—for this is indeed the responsibility of the Atomic Energy Commission—but by the production capability of a great industrial enterprise system, whose atomic products can be turned from civilian to military requirements at very short notice.

Where would we be if our production of military trucks, or jeeps, or food, or clothing, were dependent upon a governmental arsenal? The material strength of this country is its flexible production capability, which is not a drain but a strength in peacetime, and a most vital asset in time of war.

ATOMIC ENERGY AND THE AUTOMOTIVE INDUSTRY

We might attempt to visualize the ways in which atomic energy may influence the automotive industry. In considering possible uses, it must be remembered that actual applications will come into being only when they can be economically justified.

Radioisotopes are now being used in a wide variety of analysis and control problems. They are being used to study wear of bearings and other problems in automobiles, and they are being used in many manufacturing processes to provide better materials and more economical methods. It it certain that these uses will continue to expand with time and the industry can expect important advances from this phase of atomic energy.

The possible influences of the use of nuclear heat on the automotive industry seems to be indirect or secondary in nature. We know, for example, that the metallurgical processes, from the reduction of ores to the heat-treatment of semifinished parts and products, are very large users of heat. It is very difficult to visualize at this stage, however, how the direct heat of nuclear fission can be applied to these processes. The radiation problem, the extremely exacting and limited conditions under which this heat can be released, and the expensive facilities required for handling atomic fuels, make direct applications of this kind appear to be technically impractical at present.

Many indirect applications of atomic energy to metallurgical processes have been suggested. For example, in the present method of converting coal to liquid fuels, one-half of the heat energy in the coal is expended in the process, and this results in higher cost products, which cannot compete with natural petroleum. If the very low-cost heat energy of atomic fuels could be used to bring about this conversion process, on a mass basis, then the synthetic fuels might be competitive with petroleum products. This could make a new source of fuel available for metallurgical processes and benefit all users of metals. In addtion, it might provide a new competitive source of fuel for internal-combustion engines.

The automotive industry is a very large user of electricity and steam for its factories and manufacturing operations. Most electric power is purchased from central electric power systems but, in some instances, manufacturers have found it desirable to provide their own facilities for generating at least a part of the electric power they need. Steam for heating and process work usually is furnished by the manufacturers' own equipment.

If reactors can be developed for use in the generation of electricity for electric power systems, such reactors obviously might be adapted to provide the steam and electric power needs of individual manufacturing establishments. But the exclusion area requirements might preclude such installations.

According to present knowledge, reactors using atomic fuels must have a very large thermal and electrical capacity to be competitive with conventional fuels. Units that will produce at least 100,000 kw of electricity, and perhaps more than 200,000 kw, are being considered. Most manufacturing establishments could not use units of this large capacity for electric power or process steam.

Investment is an additional factor in the problem of self-generation of electric power. Nuclear reactors will require a very high investment as compared with conventional fuel-burning boiler plants. Most manufacturing companies find that available investment funds can be used much more profitably to provide better manufacturing facilities than to provide electric power generation.

When all of the considerations are weighed, it appears that there will be no great change in the present practices of electric power supply for most manufacturing establishments.

With respect to electric power, the automotive industry should certainly benefit by whatever degree the costs of power generation can be reduced through the use of nuclear fuels. And indirectly, the successful development of power generation by atomic fuels will have a stabilizing effect on all fuel costs.

One of the very important energy requirements of the automotive industry is fuel for the internal-combustion engines that power our automobiles, trucks, and tractors. The use of fissionable materials as fuels for automotive propulsion is a most intriguing thought. Dr. Lawrence R. Hafstad, director of the Reactor Development Division of the

Atomic Energy Commission, has indicated that a reactor for an automobile would consist of a critical mass of plutonium, possibly one or two feet in diameter, surrounded by a concrete shield at least six feet thick. Such a device would hardly fit in your gas tank.

An equally important consideration has to do with costs. The average automobile today during its life uses gasoline costing probably not more than $1500. It does not seem practical at present to contemplate the use of atomic fuels in the effort to economize upon this small part of the expense of operating an automobile.

There is some discussion among those best informed, however, about a group of fission products called "fips," which have remarkable properties in giving off large quantities of heat and which may be more easily handled than plutonium or uranium 235. These would be costly materials, but there is the possibility that in five, or ten, or twenty years we might be in the Buck Rogers era.

In general, it appears at the present time that atomic energy will not have immediate direct effects upon the automotive industry. Indirectly, however, through the use of radioisotopes, improved metallurgical processes, and in many other ways, the industry is certain to benefit.

In anticipating the future of atomic energy development in all its aspects, we might well look back over the development of the automotive industry.

The Ford Motor Co. is celebrating its 50th anniversary this year, and other companies date back to about that time. Early models of automobiles had been produced ten to twenty years prior to 1903.

In the fifty years since 1903, the automobile has been developed and has radically changed our entire way of life. The automotive industry itself is one of the key factors in our industrial and social development. It provides direct employment for, possibly, one million persons, and indirect employment for several millions. It is one of our largest industries.

The most significant evidences of this industry are the more than forty million automobiles, trucks, buses, and tractors that are now in daily use throughout our land. They provide an easy, flexible means of transportation for our people and for all kinds of industrial and agricultural products. They supply the mechanical power to operate our farm machinery and to carry on heavy construction work. They are indeed a miracle of the age.

Each of these operations requires the use of energy, supplied, in this case, largely from petroleum products. But the important fact is that each of these forty million vehicles represents an application of energy to help us in our daily responsibilities and to maintain our way of life. We have been able to harness energy using the internal-combustion engine to the benefit of mankind.

This remarkable automotive development has been brought about by initiative and enterprise of the highest order. Individuals and private investment provided the technical knowledge, the vision, and the driving force. The opportunities for advancement and enjoyment of the benefits which have been derived—sometimes called profits—provided the incentive. These same forces keep the automotive industry virile and vigorous today.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

AS WE GO TO PRESS:

Government Considers Releasing Atom to Industry

A CHANGE in policy on use of atomic energy for electric power and industrial uses is under way in Washington. The Joint Committee on Atomic Energy is expected to consider a modification to the McMahon Act which may erase the barriers discussed by Cisler in this article.

The changes being proposed will:

1. Permit licensed private companies to get enough uranium to generate electricity and produce fissionable materials.

2. Allow companies who build and operate reactors to sell fission byproducts to the government for use in atomic weapons.

3. Modify the present Atomic Energy Act to offer some patent protection to those conducting private research and development.

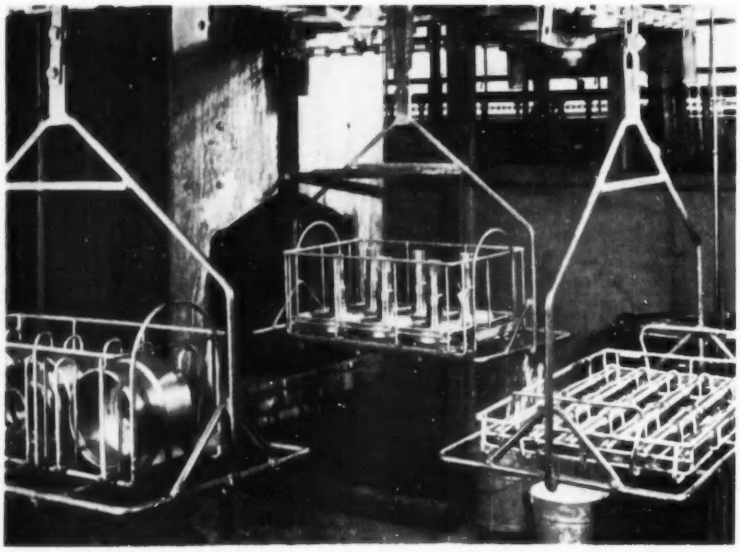
Current reports have it that these proposals are in for some rough sailing. Despite the green light that the administration has given the proposed program, several congressmen are opposed to the move at this time. They feel the time is not yet ripe for loosening atom controls in the light of the continuing weapons race with Russia.

7 Hot Tips on

How to Make Tricky

H. H. Whittingham, Detroit Gear Division, Borg-Warner Corp.

Based on paper, "Unusual Problems in Machining Automatic Transmission Parts," presented at SAE National Production Meeting, Cleveland, March 26, 1953. Complete paper in multilithographed form may be obtained from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.



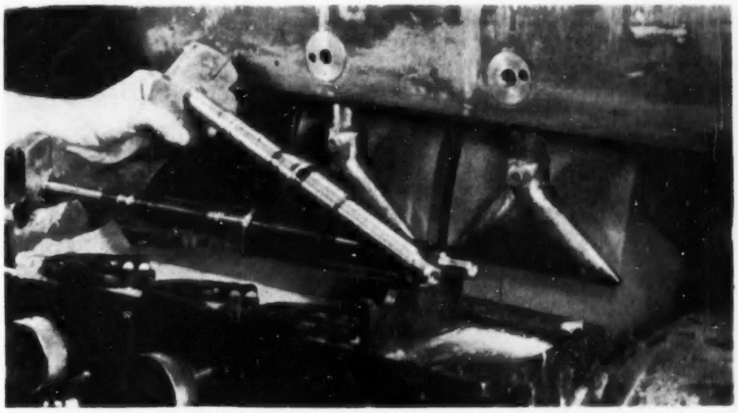
1. Keep It Clean!

Keep it clean should be a hard-and-fast rule . . . for anything over ½ gm of foreign matter in the whole transmission assembly is taboo. Use of wire baskets to distribute parts to assembly locations promotes cleanliness in a big way. Since they have open bottoms, dirt can't accumulate in them. They have no wooden pegs from which splinters can peel off and find their way into a transmission. And in going through washing machines, water can flow freely over the parts and through the basket—removing all dirt from both.

What's more, baskets such as these stack easily, are easily loaded on to tray conveyors, and keep gears and other delicate parts from being banged up.

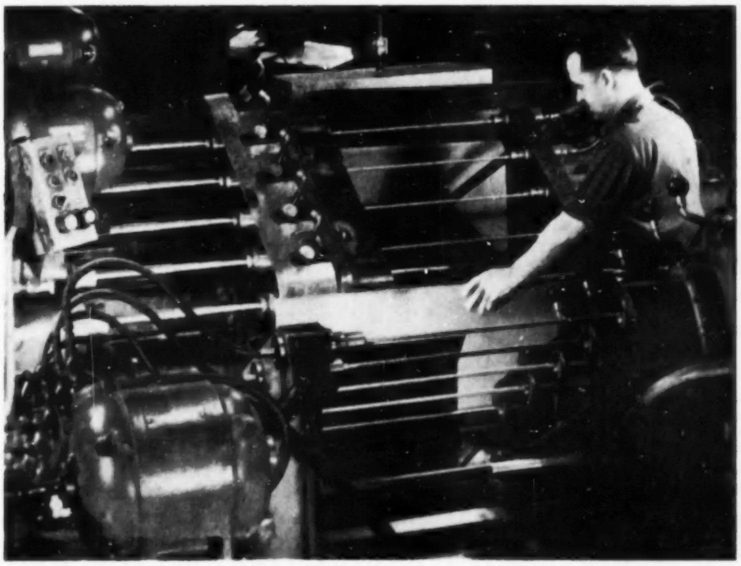
To really make the most out of parts-carrying baskets though, (1) assembly rooms should be pressurized and air conditioned, (2) dust should be kept down by using vacuum cleaners during working hours and washing the floors between shifts, and (3) no air hoses, rags, wood, leather hammers or any other fibrous material that can break up into foreign matter should be permitted in the assembly room.

Automatic Transmission Parts



2. Bucktoothed Wheels Grind Five Diameters

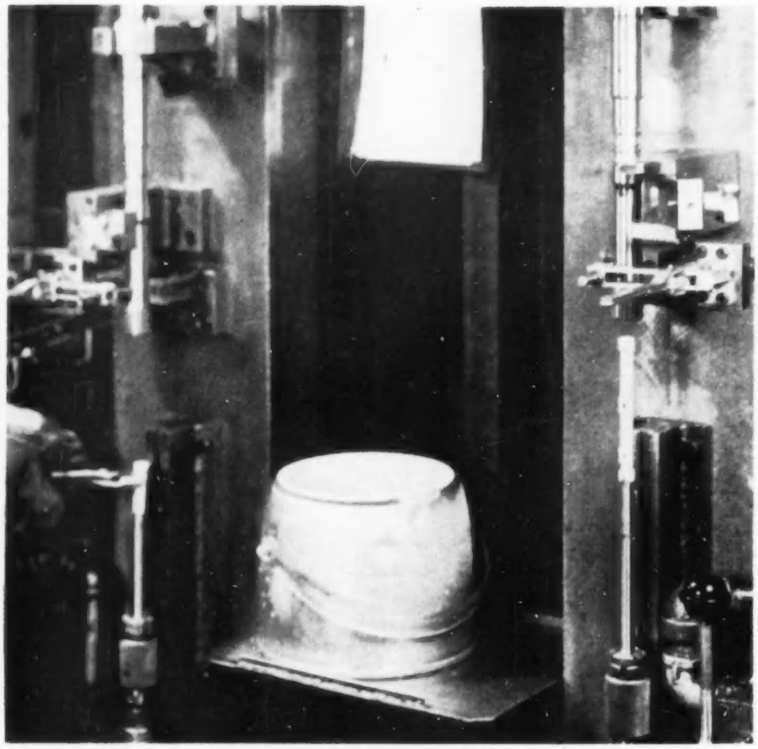
Five bearing diameters on the transmission mainshaft can be ground at the same time with this unique grinder. Success of the operation naturally depends on the design and accuracy of the wheel dresser. Diameters are successfully held to 0.005 in.



3. Reamer Gets Its Walking Papers

A reaming operation can be eliminated by gun drilling long holes to size. In fact, gun drilling alone gives better finish and closer tolerance with the 14 in. oil passage drilled through the center of the transmission mainshaft.

Holes are drilled in 5-spindle gun drilling machines at the rate of 52 per hr. The drills are held stationary and the pieces rotated at 1500 rpm by two machines.



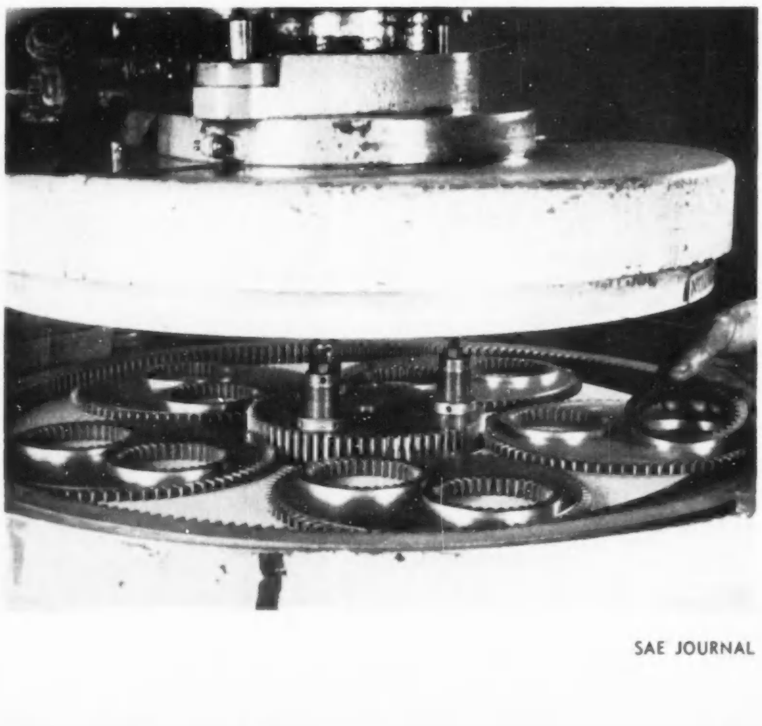
4. No Squeeze With Nitrogen Freeze

Freezing parts with liquid nitrogen makes possible all the advantages of press fits with none of the disadvantages.

For example, this solved the problem of how to secure the two valves in the transmission mainshaft. Scratches made by pressing the valves into the hole had caused oil leakage and malfunctioning of the transmission. But dipping the valves in liquid nitrogen does away with all that. They shrink enough so they drop freely into the holes . . . then thaw out to metal-to-metal 0.001 in. press fits.

5. Ten Laps at a Clip . . . Make for Fits

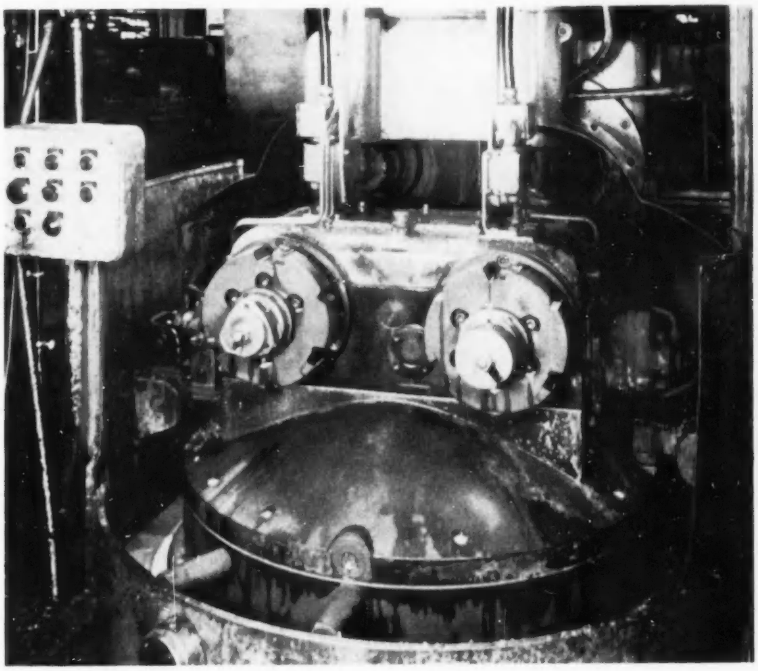
Selective fitting to hold down end play between pump gears and cover can be eliminated by lapping the gears to a 0.002 to 0.003 in. tolerance. The lapping machine shown can do this at the rate of 200 gears per hr.

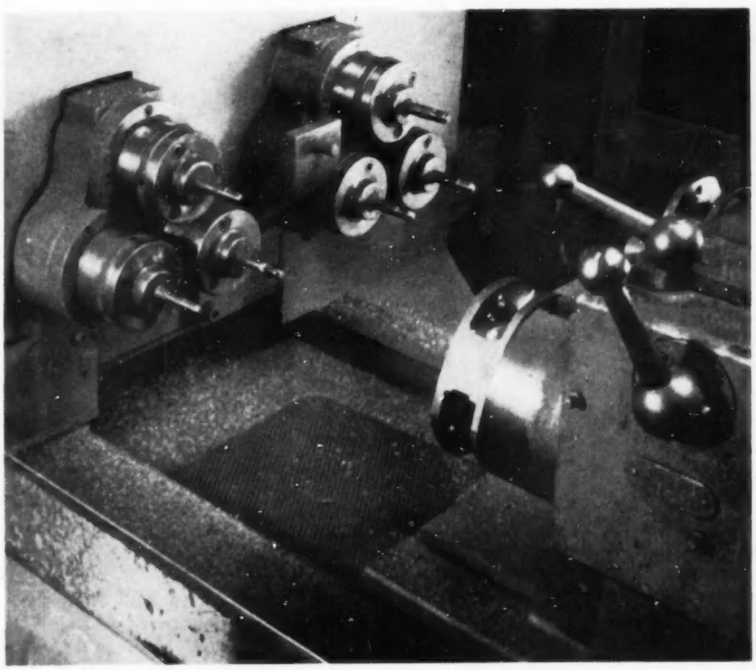


6. Precision Milling "Wraps Up" Slots

Cutting of the pinion slots in planet carriers can be done in just one milling operation. With the 0.001 in. tolerance that can be obtained, there's no need for a finishing operation.

As shown on the right, one carrier is milled while two are being loaded. There is automatic indexing for each of the three slots. The fixture itself is mounted on a turntable which indexes 180 deg.





7. Preset Clusters Make No Errors

Use of precision-made clustered boring heads insures that gear pin holes are put in the right spots on the planet carriers. It's a better system than the indexing approach because once center-to-center distances are established they can be maintained. There's no wearing of parts to throw things out of whack as is possible with an indexing mechanism.

PRODUCTION TOMORROW

Moving Tons or Ounces... All in Day's Work at

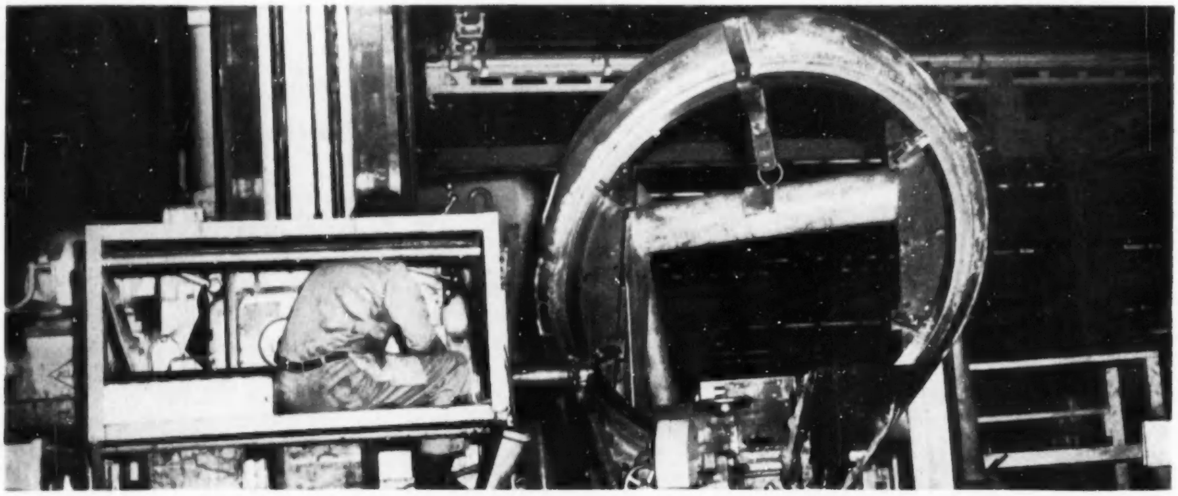
THE production volume is smaller and the vehicle produced is much larger. But the materials handling at Cadillac's Cleveland tank plant was sired by the same engineering thinking and planning that goes into car plant operations in Detroit.

That's what many of the several hundred visiting engineers felt during the trip through the plant on March 27, during the SAE National Production Meeting in Cleveland.

Lifting and moving parts that make up the 26-ton Walker Bulldog tank gets to be tricky business. In creating their handling devices, the engineers at Cadillac hew hard to practical criteria. They ask themselves such questions as:

- What's the simplest way of doing this job? (Men in the shop just won't use complicated devices.)
- How can the handling help simplify the production operation? (The welding merry-go-round is an example.)
- Can we get away from conveyors? (They feel their volume doesn't warrant much conveyorization, and the trackless train is one alternative.)
- Can we come up with a special lifting device that gets around cable, which gets cut up and has to be replaced?

The photographs that follow are some of the materials handling features seen by the SAE group.

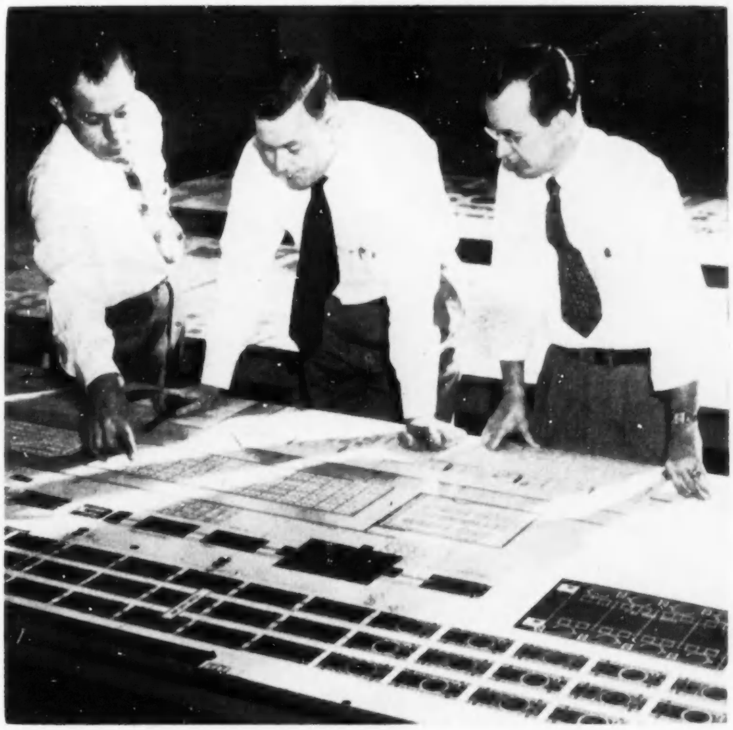


SPECIAL LIFTING DEVICES such as this one manipulate heavy, clumsy parts with ease. For this trunnion assembly, being machined on a Sellers boring machine, a fixture with a low lifting point was built to give hoist enough clearance

Cadillac Tank Plant

MATERIALS HANDLING ends when the Walker Bulldog tank comes off the assembly line under its own power at the Cadillac tank plant. But prior to this point, varied lifting and moving devices are applied in manufacturing operations throughout the plant

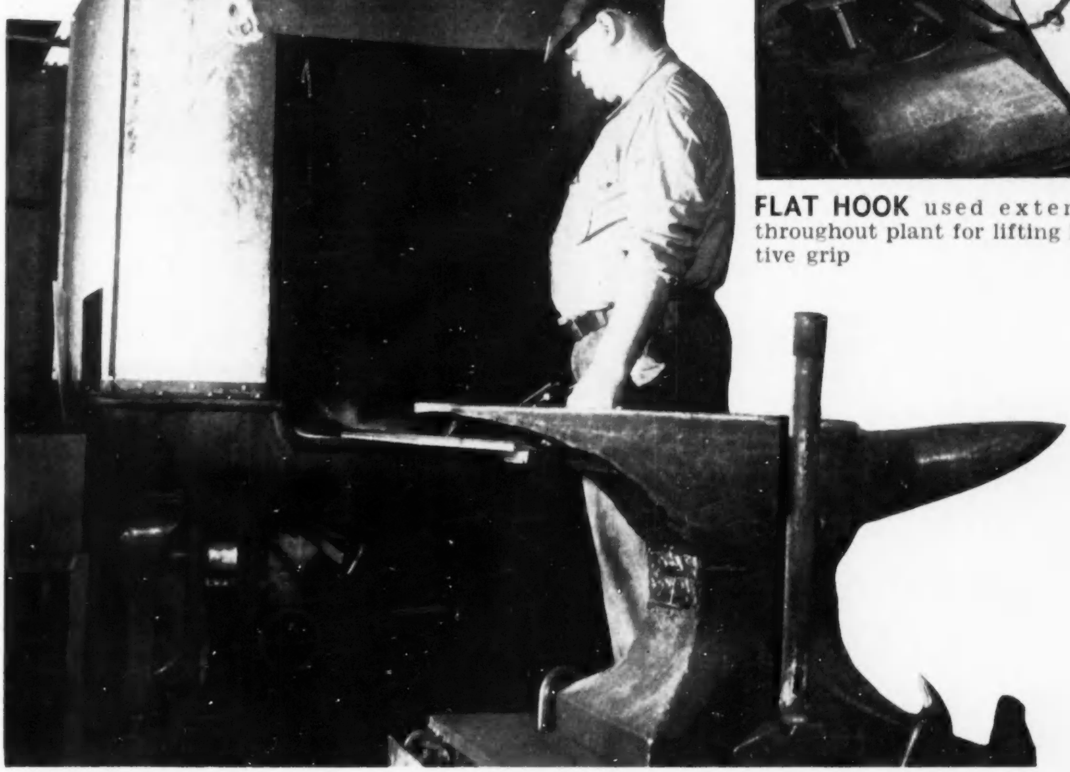
EVEN PAPER gets engineered handling. Confidential documents are disposed of in wire baskets



PLANT LAYOUT TEAM with big and small handling problems alike, is always careful to keep loads within limitations of building structure erected to produce light plane parts

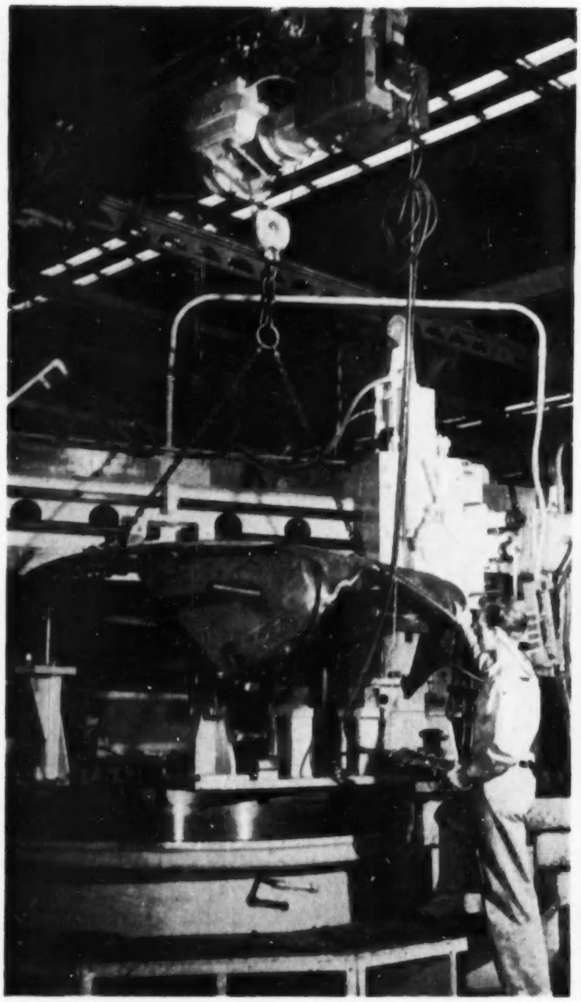
WELDING MERRY-GO-ROUND takes the toil out of welding. As tank hull moves from station to station in circular welding line, it also gets turned gyroscopically. That's to make for a horizontal weld, to get away from vertical and overhead welds. This simplifies welding, cuts down welder training time. That's particularly important since there is a shortage of welders in Cleveland and Cadillac trains practically all of its welders. These special fixtures make it possible for women to do welding. A second welding merry-go-round handles tank turrets

FLAT HOOK used extensively throughout plant for lifting has positive grip

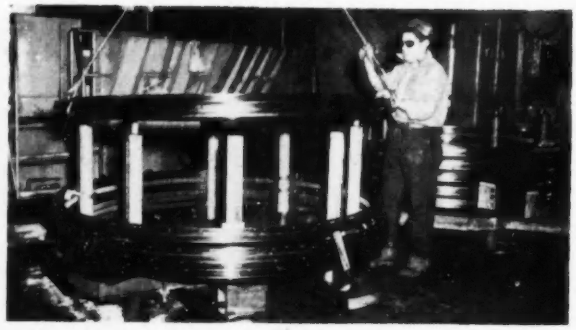


BLACKSMITH plays a part in building mechanical "horse" power. At Cadillac tank plant he makes ingenious, but simple handling devices, such as hooks in upper right-hand corner

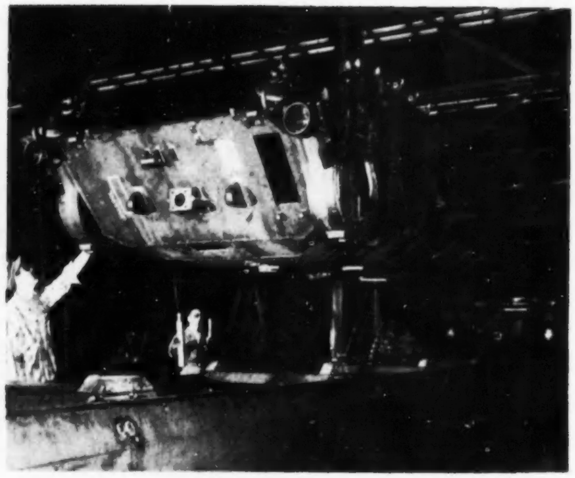
TRACKLESS TRAIN makes appointed rounds throughout plant several times each day. It drops off trailers with needed parts and materials at given stations and also picks up empties. Automatic hitches on trailers simplify operation



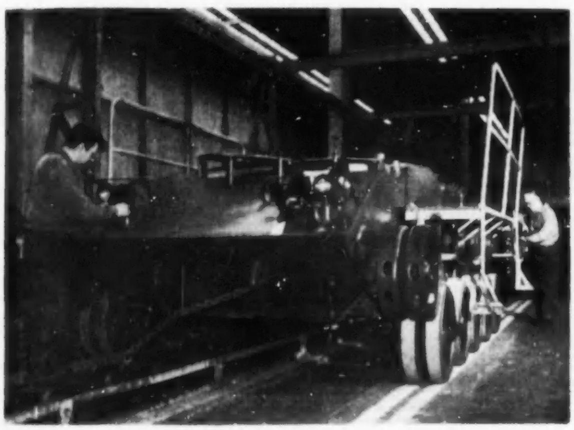
BACKFLIP given to ring and trunnion assembly, with help of special lifting device, sets part up for machining



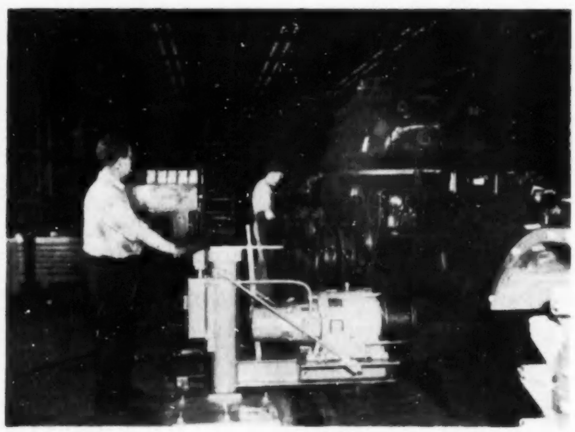
RING RACK stays with ring gears through intra- and inter-plant movement. It saves time and prevents damage to parts



TROLLEY CARTS onto which hull is being lowered are part of endless conveyor at start of assembly operations



DRAG LINE CONVEYOR pulls tank along on its own wheels as hull moves along final assembly line



TRACK joins tank with aid of winch, while a second winch is pulling tank off drag line conveyor

PRODUCTION TOMORROW

Plastic Car Bodies

. . . send body designers into ecstasies–production men for the aspirin. For while glass-reinforced plastic packs some exciting properties, ways still have to be found to fabricate the stuff faster.

E. S. Ebers, Naugatuck Chemical Division, U. S. Rubber Co.
I. M. Scott, Winner Manufacturing Co.
Games Slayter, Owens-Corning Fiberglas Corp.

Based on papers, "The Cement of Reinforced Plastics for the Automotive Industry," by Ebers; "Problems, Production and Techniques of Laminated Fiberglas," by Scott; and "Will Glass-Reinforced Plastics Replace Metal in Automobile Construction? If So, When and Where?" by Slayter presented at SAE Annual Meeting, Detroit, Jan. 13, 1953.

GLASS-REINFORCED plastics may soon give steel some stiff competition for the passenger-car body market. Already the stuff has its foot in the door (see accompanying box and picture-caption story). But before it gets in, production men and material suppliers are going to have to do a little door-opening of their own.

Present methods for fabricating reinforced-plastic bodies won't do. Most require a great deal of hand work and are just not capable of high-volume production. What's more, quality of products produced by such methods depends too much on ability and craftsmanship of individual workers. Quality control and finished-part testing are major problems. Nondestructive tests are not generally available.

Need Tailormade Machines—Not Stepchildren

Even in cases where mechanical equipment is used to put the glass and plastic together, wholesale improvement is needed. Some equipment, it is true, has been conceived, engineered, and even made by individual fabricators . . . and it does a good job for certain parts. Other machines, however, are mere stepchildren—adapted from those used by other industries.

The ability of glass-reinforced plastics to compete with steel for passenger-car body use then hinges on better fabricating equipment and techniques being developed. But it also depends on suppliers coming up with more usable forms of the material. It's important that fabricators get the stuff in a physical condition suited to mass production. The present system of supplying users with basic constituents (glass fiber mat, glass cloth, and resin) won't do. Production men are going to need prefabricated, easy-to-handle sheets.

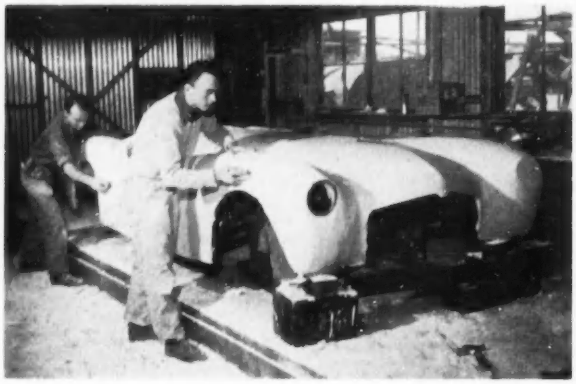
Possibly some large passenger-car manufacturers will want to produce their own stock so as to get color and surface control. However, most subcontractors will not want to be bothered with the chemical problems of plastics and catalysts any more than they want to be metallurgists today. But in either case, whether supplied by material maker or fabricator, sheets of the material are a must for high-volume production.

This isn't the only assist that production men will have to get from material suppliers. If bodies are to be mass-produced, then the plastic itself will have to have a high heat-distortion level and a rapid-molding quality. Fortunately such plastics can be had when the demand justifies them.

Designers See Flock of Advantages

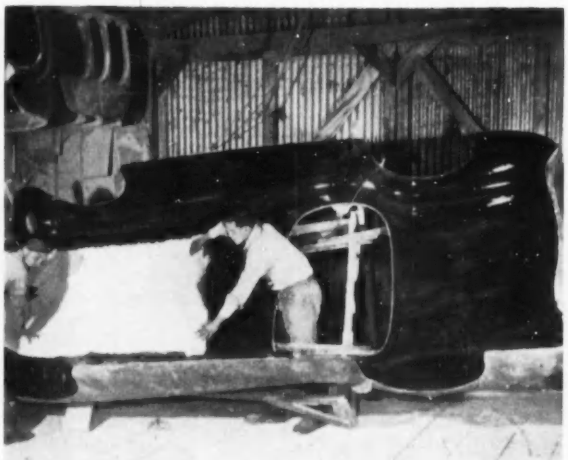
Production men, then, envision a raft of problems connected with mass production of reinforced-plastic car bodies. Why, then, are body designers so enamoured with the material? It's because they

How Reinforced - Plastic Car Bodies Are Made Now



MOCKUP—Initial step in the manufacture of the glass-reinforced plastic body for the Alembic I is to make a wood and plaster mockup. This master mold must be given an extremely smooth finish since it will impart this finish to the female production mold . . . and ultimately to the final body. Ensuing waxing, polishing, and spraying with cellulose acetate assures that the female mold will break away cleanly and easily.

FEMALE PRODUCTION MOLD—First step is to apply a fast curing coat of resin to the mockup. This ensures a perfectly smooth surface on the production mold. Next five alternate layers of glass fiber mat and glass cloth are laid up with resin worked into each layer. After cure, steel brackets are attached to the mold to give it rigidity. The mold is removed from the mockup in two halves, but flanges assure smooth joining later on.



BODY LAYUP—The body is laid up in the female mold and is constructed in one piece. Here again, the first step is to apply a fast curing coat of resin to the mold (to assure a smooth, pinhole-free surface on the final body). Then the body layup is started with a glass mat . . .

. . . Glass cloth is laid over the glass mat and coated with resin. This process is repeated with second layers of glass mat and cloth—then the body is allowed to cure in the mold. Portable infrared lamps may be used to speed the curing process . . .

see a host of desirable properties in the stuff. Here are some of the things they especially take to:

The material has a high strength-weight ratio. For equal strength, one pound of resin-glass laminate can replace three or four pounds of steel! Enormous parts of great strength can be produced —all in one piece. Color can be molded right in.

The material can withstand rain, sun, frost, and snow without crazing, cracking, or warping. Some combinations of glass and resin can take heat up to 500 F. The stuff is noncorrosive, translucent, a good electrical insulator, and can be made resistant to acids, alkalis, oil, gasoline, and corrosive gases.

What's more, it resists cold and heat transmission and is cheap and easy to repair. Damage, which appears as a puncture or a crack, can be rapidly repaired with only heat and patching. It doesn't have to be bumped out with dies, shapes, and hammers.

As for safety aspects, the damping power of fibrous glass and plastics should result in less drastic human injury in accidents. Unlike metal with its collapsing, tearing, pinching characteristic, reinforced plastic springs back into place.

To make the cheese more binding, these and other attributes of glass-plastic laminates have been proved out in over 28,000 miles of operation of a test model throughout the U. S.

But be that as it may, production men—not body designers—are the ones that are really going to have to be sold on plastic car bodies. For while glass-reinforced car bodies are a designer's dream, they're still a production man's nightmare.

(Papers on which this abridgment is based are available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Based on Discussion

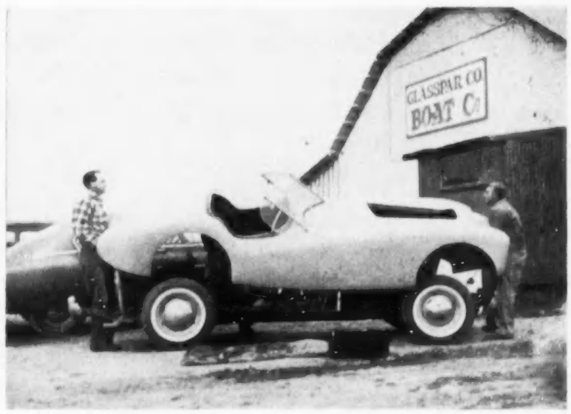
Question: What would tooling costs be for a reinforced plastic car body?

Answer: Based on 5000 units per year, the total cost using an aluminum female mold would be approximately $100,000. This would amount to $20 per body.

Question: How long does it take to cure glass-reinforced plastic parts?

Answer: At the present time most parts from matched metal dies require 5 to 7 min. This

. . . After removal from the production mold, the body is buffed, corners and edges smoothed. Flash or overhang is easily removed with a hacksaw or power grinder . . .



. . . Splash pans are then added and the body is painted. The finished body weighs approximately 185 lb and its average thickness is 0.20 in.

curing time must be cut to less than a minute if mass production is to be realized.

Question: What resins are available that will permit fabricators to obtain several parts per minute from a press?

Answer: A thermo plastic molding compound of polydichloro-styrene and chopped strand glass mat is currently available in limited quantities. Right now the material is quite expensive and the supply is pretty well taken up by the military. However, other plastics, such as phenol-formaldehydes, show very good properties.

Question: Have workmen using fibrous glass experienced any irritating physical effects?

Answer: Doctors have discovered that fibrous glass has no ill effect on the respiratory system. Where machining of fibrous glass parts is necessary, exhaust fans usually eliminate complaints. The few people who are allergic to skin irritations can be helped by protective skin creams. Some believe that glass "itch" is 98% psychological.

Question: What will be the future cost of fibrous glass?

Answer: The most important factor in future cost reduction will be increased use of the material.

Question: Has any research work been done on combining fibrous glass and metal?

Answer: Such combinations have been found unsatisfactory because of the vast difference in the modulus of elasticity of fibrous glass and most metals.

Question: What are the aging characteristics of glass-reinforced plastics under atmospheric conditions?

Answer: The best example of aging characteristic of the material is the fact that it is satisfactorily used in a great many boats which operate under extreme salt and moisture conditions.

Chevrolet and Kaiser-Frazer to Make 1953 Sports Cars with Plastic Bodies

Glass-reinforced plastic is already giving steel a run for the money as a material for sports car bodies. Two passenger-car makers will use it on soon-to-be-introduced sports cars. And four other companies are interested enough in the stuff to have made experimental cars with plastic bodies.

The material is to be used for the body of the Chevrolet Corvette—a sports car which will be put in production in June.

Kaiser-Frazer, too, plans to market a '53 sports car with a glass-reinforced plastic body—the Kaiser-Darrin Model KF-161. It's to be volume produced starting in July.

What's more, Lincoln, Oldsmobile, Buick, and Cadillac have gone so far as to make plastic body sports cars to see what can be done with glass-and-plastic.

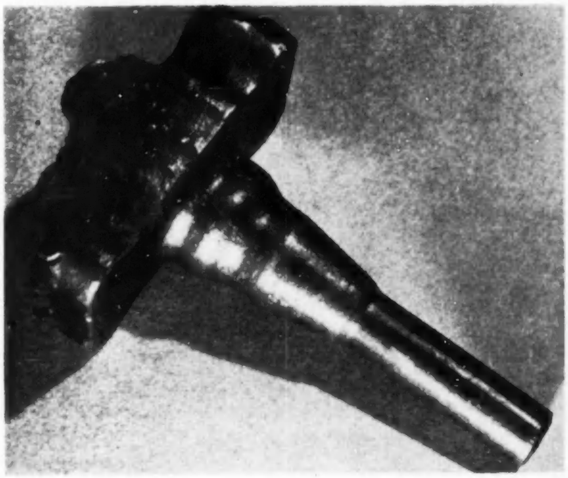
PRODUCTION TOMORROW

Extrusion Really Arrives!

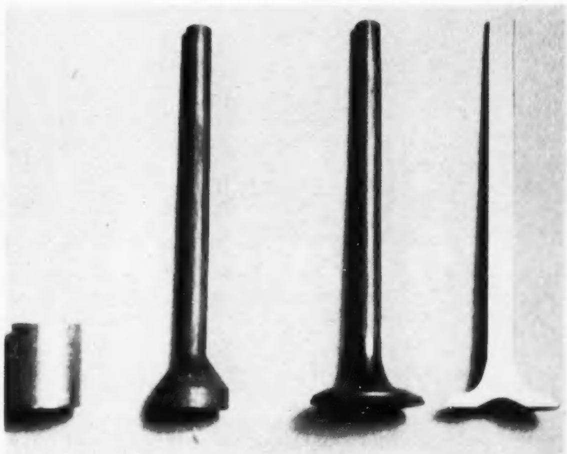
No longer is extrusion of steel a slow, expensive, tricky operation confined to a few parts. Today's automatic machines can turn out a flock of steel parts at terrific rates . . . and whopping-big savings in material and labor.

John H. Friedman, President and General Manager, National Machinery Co.

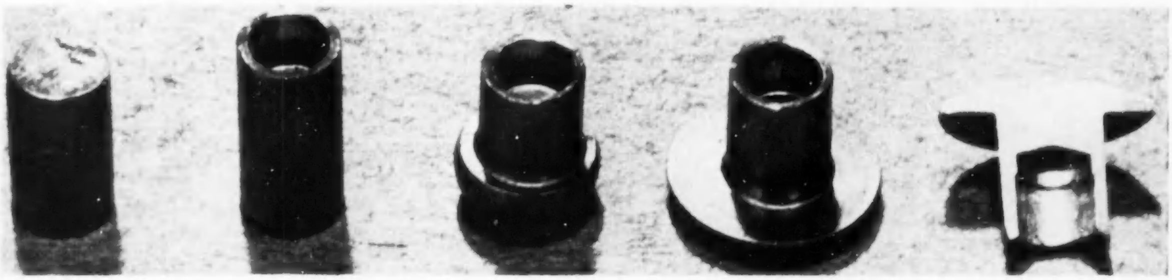
Based on paper, "Hot and Cold Extrusions," presented at SAE National Production Meeting, Cleveland, March 26, 1953. Complete copy of paper is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.



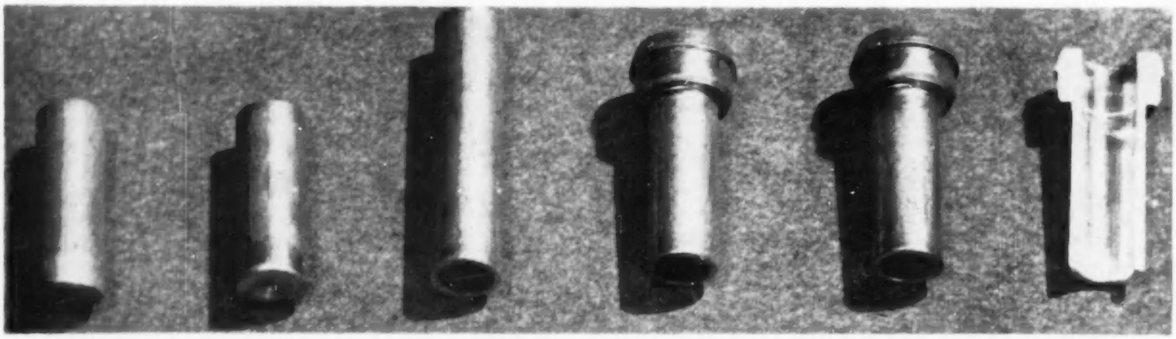
WHEEL SPINDLES now made by hot extrusion machines not only cost less to make—they're stronger, too. Compared to drop-hammer forgings, material savings amount to 30% . . . labor costs are 65% lower . . . dies cost only 60% as much. What's more, improved flow pattern of extrusions gives 17.3% greater fatigue life than that of hammer-forged spindles.



ENGINE VALVES can be extruded at a fantastic rate. Using latest automatic heating and handling methods, it's possible for one man to coax 1000 valves per hr from today's highly developed extrusion presses. It takes but two operations to transform stubby, round billets (1 in. in diameter by 1-5/32 in. long) into 5$\frac{3}{8}$ in. long valves with 1$\frac{1}{2}$ in. diameter heads.

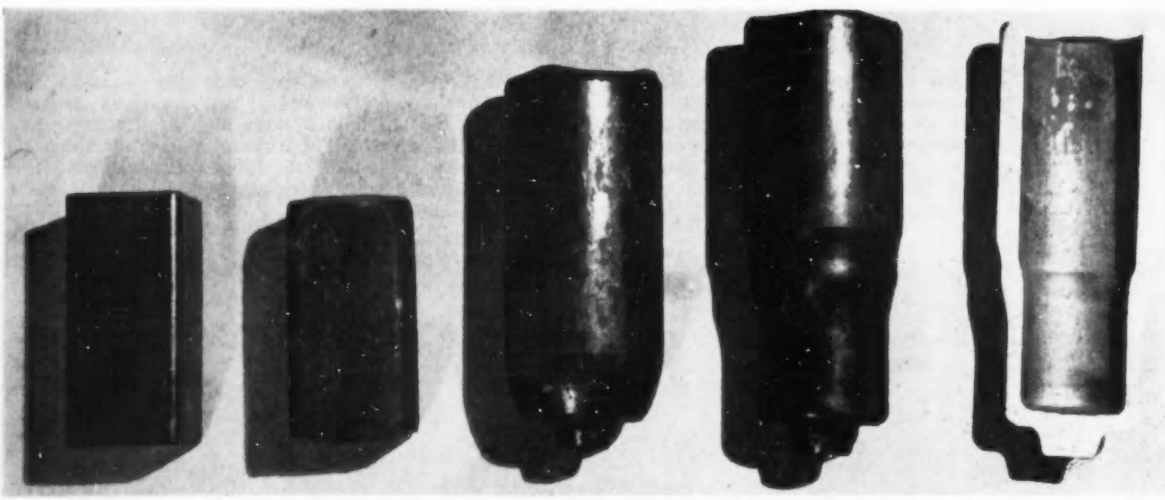


TUBULAR RIVETS can be produced far cheaper by current automatic extrusion machines than by the old method of cold heading and drilling. First, metal is extruded over an extrusion punch . . . next, material is gathered for the head . . . then finish-heading completes the operation



HOLLOW RIVETS are now commercially practical—thanks to extrusion. No longer is scrap loss prohibitive. It's only one-fourth as much as that obtained with the former method of drilling out the hole.

TAIL CONES are still other items that can be produced most economically today by extrusion. Walls of this ordnance forging are extruded in tapered sections to get the correct amount of material for expanding to the cone shape. Concentricity is held within 0.008 in. at an everyday production rate of more than 400 extrusions per hr.



ROCKET HEAD forgings are unusual in that they are hot-extruded from round-cornered square stock. Even now they can be turned out at the healthy rate of 300 pieces per hr. But just as with all steel extrusions today, the surface has barely been scratched. As better die steels and lubricants become available, extrusion equipment will be developed that will increase even more the desirability of extruding steel parts.

Meeting Asserts Production Man Is Key to PRODUCTION TOMORROW

WANTED: *Ways for manufacturing men to lower production costs, ways to exercise greater controls over operations, new and better processes, and people who can cope with the growing complexity of manufacturing operations.*

REWARD: *Greater productivity, lower unit costs, and higher quality.*

That's pretty much the challenge made to more than 600 manufacturing men at the SAE National Production Meeting in Cleveland, March 25-27. It was echoed and paraphrased at the eight panels of the Production Forum, at technical sessions, in talks at the dinner, and during the plant trips at Ford and Cadillac. From this melting pot of ideas, as General Chairman Paul Miller labelled the meeting, came these specifics:

Take out the human drudgery in manufacturing and replace it with machinery and costs will go down, quality up. The completely autuomatic factory is still a long way off, said D. S. Harder and D. J. Davis, of Ford. But the shift to automatic parts handling is a step in the right direction.

A case in point is Ford's new engine plant in Cleveland. There, automation (or automatic handling between operations) has paid off. The savings realized in the Cleveland plant have been enticing enough to generate additional automation programs in the Ford organization. Said Harder, Ford is installing an automated line at the Rouge plant, which should be completed this summer.

Many of the men at the meeting who heard Harder and Davis describe the Cleveland Plant also visited the Ford installation. Some of the things

they saw are pictured in this issue on pages 38–45.

Another tip on cost reduction came from Emil Gibian, of Thompson Products. He contended that half the machine tools in this country are obsolete. Replace them with modern equipment, he said, and you'll double productivity without any speed up.

Keeping Tabs on Things, People

Growing complexity of product and plant machinery, automaticity, and size of operations make it tougher for management to control a manufacturing enterprise. At technical sessions, production engineers argued methods of drawing up management blueprints . . . programming and planning objectives. Forum panel sessions sorted methods of controlling the various operations so that end results come close to planned goals.

J. B. Lathrop, of Arthur D. Little, proposed operations research as a new decision-making tool for manufacturing men. He said it furnishes a more integrated basis for making decisions. That's because O.R. finds, measures, and evaluates the factors that bear on a given problem. O.R. picks up where industrial engineering leaves off, opined Lathrop.

Trick is to find the mathematical model that expresses the given situation. And it's been done for production and inventory scheduling under highly fluctuating sales, for planning machine runs, and for evaluating new products.

Lathrop said it takes a three-man team from four to six months to work up an operations research answer to general production, scheduling, and distribution problems. Several engineers at the meeting went along with the feasibility of a mathematical model. The big question mark to them is finding the values to use in the equation.

In day-to-day operations too the search is on for closer controls. Television for viewing widespread operations and electronic devices will help achieve this in the factory of the future, said E. F. Gibian. A number of plants already control industrial trucks with two-way radio.

Those at the Forum panels needed little to convince them that control is the big industrial attention-getter today. The Production Control and Quality Control panels drew the biggest audiences.

The Big Hurdle: Processing

Advent of new materials and growing scarcity of old ones were said to be responsible for challenge No. 3—improved manufacturing processes. For example, SAE President Robert Cass said the U. S. population will grow at a faster rate than copper production. Already each car manufacturer is

Cleveland Coronation

The crowning of SAE President Robert Cass as king of engineers by E. K. Brown (left) and R. F. Steeneck (right) capped a series of skits depicting the life of the President. The eight-act biography—complete with old cars, pretty young girls, and colorful scenic settings—was created and acted by members of the SAE Cleveland Section.

The acting troup consisted of Al Gilchrist, John Post, Ray Potter, and Walter Luli. Handling the backstage chores were Ted Thoren, Bob Steeneck, Bob Widder, Ted Scott, Oscar Smith, and Lowell Ray. Bob Vogelei was chief electrician. George Scragg and Ned Brown dished up the poetry and narration.

They Planned

Plans for the meeting were made and carried out under the direction of (left to right) E. D. Kemble, meetings vice chairman of the SAE Production Activity Committee; General Chairman Paul A. Miller and Neil P. Petersen, vice president for Production Activity

They Operated

General Chairman Paul Miller had the help of these able lieutenants during the meeting. They are (left to right): O. W. Smith, chairman of the Reception Committee; Dexter S. Kimball, in charge of publicity and membership vice chairman of the Production Activity Committee; and Kenneth M. Randall, in charge of plant tours and bus arrangements

They Talked

Prominent in the dinner program were Toastmaster A. T. Colwell (left) and E. K. Brown, vice chairman of the Cleveland Section

running cars with experimental aluminum radiators. Only trouble with aluminum radiators is that no one knows how to fabricate them easily in large production quantities.

Hot and cold extrusions are saving materials and manufacturing time, showed J. H. Friedman, of National Machinery. He said the extrusion technique is awaiting better die steels and lubricants. With them, even greater gains are in the offing.

Materials suppliers are ahead of fabricators in the case of titanium, reinforced plastics, and shell molding, it came out at several sessions.

Designers too are putting the squeeze on production men. Automatic transmissions are a case in point, said H. H. Whittingham, of Borg-Warner's Detroit Gear Division. His company's self-shifting drive calls for unusually high standards (for the automotive industry) in parts cleanliness, tolerances, and assembly precautions.

Point No. 4 made at the meeting is that the modern manufacturing operation demands more alert, more knowledgeable men up and down the line. According to Harder, it takes higher skills to service production lines in the automatic factory. The automation engineers designing these plants must have extensive specific knowledge as well as broad perceptions.

Lathrop's display of the usefulness of operations research implies manufacturing management men will have to be more scientific. Gibian says these men will have to make calculus and differential equations a part of their kit of tools.

Around the Meeting . . .

President Cass told of being impressed with a motto on a building in Washington. It said: "The past is but a prologue. . . ." Cass commented to his cab driver about it. "Oh, that's just Washington double talk," said his cabbie. "What it really means is 'Brother, you ain't seen nuthin' yet.'"

• • • •

Toastmaster A. T. Colwell said General Groves doesn't expect an atomic attack on this country via bombers flying over the north pole. One morning we'll be told by the enemy that 50 A-bombs have been planted in our key cities. If we don't meet his demands, he'll detonate them all at once.

• • • •

Emil Gibian told of little Johnny who was asked by his teacher: "Who signed the Declaration of Independence?" "I'll be darned if I'll tell," Johnny replied to his teacher. Horrified, she took him before the principal, and Johnny was asked the same question, gave the same reply. So Johnny's father was asked to come to school. In his father's presence, the teacher again asked Johnny who signed the Declaration of Independence and again he said "I'll be darned if I'll tell." At that his father grabbed him by the shoulder and said, "John, if you signed the Declaration of Independence, I want you to admit to it."

• • • •

Overheard at SAE Council meeting as John Warner was trying to decode the hand-written comments of a Councilor: "If you could read his writing, you'd comment on his spelling."

• • • •

Smooth running of the technical sessions stemmed from the effective jobs of the two session chairmen, Bob Steeneck, of Fafnir Bearing, and Edwin Crankshaw, Cleveland Graphite Bronze. Secretaries for the sessions were Al Gilchrist, of Leece-Neville, and Ted Thoren, Thompson Products.

Prexy Performs on TV

On the evening of March 26, SAE President Robert Cass was interviewed by news broadcaster Dorothy Fuldheim over TV station WEWS. The remarks President Cass made on the telecast he expanded later that evening in his dinner talk on "Preparedness and Production." Among the things he said were:

"It is not enough to say that if you have material available, you can have large production, that you can have efficient and low cost production. There must be imagination . . . there must be a full grasp of the fundamental reasons behind mass manufacturing that will obviously grow more readily and more certainly in a country in which 'freedom' is a commonplace and everyday matter."

In discussing availability of steel, aluminum, and copper, Cass said: "Our steel picture is a happy one. We control it largely here in North America and can increase it at will if necessary. . . . With respect to aluminum, we may be equally as certain that real progress is being made to have available more than just a partial mobilization program. Given a few years of peace, we shall have such a stockpile of aluminum produced right here in America and put aside for emergency use as to make it possible for us to continue a healthy civilian output of goods, even when a full-scale war might be raging. . . . When we come to copper, we have another picture. Up to date it has not been possible to stockpile any degree without causing a rate of production in the civilian side of our national life, that of itself, was not sufficient to guarantee a successful, well-balanced economy. We shall have to find what can be done to meet this scarcity."

On the Screen

In the Studio

Forgings

Preventive Maintenance of Plant Equipment

Grinding and Cutting Tools

Foundry

Progressive Assembly Techniques and Methods

SAE Production

THREE threads wove themselves through varied patterns at the eight Production Forum panels where more than 500 manufacturing men gathered to talk:

1. Swapping stories about individual experiences was the top-value item at most of the Forum sessions. "It all depends on the particular situation" was concluded much oftener than principles or standards were evolved;
2. How people act and react is the nub of as many manufacturing problems today as is any single mechanical item;
3. The manufacturing man, to do his best job, wants and needs more direct contact with the engineers in his customers' organization . . . much more than he commonly gets.

At the sessions on Materials Handling, Foundry, Drop Forging and Grinding and Cutting particularly did the exchange of individual experiences make a major contribution. The importance of how to position, inspire, and get the best from people came up prominently at the sessions on Quality Control, Progressive Assembly problems, Foundry, Materials Handling and Production Control. Customer relations problems got a good going over at Production Control and Foundry sessions, although they entered almost everywhere at one time or another.

At the Quality Control panel, for example, much of the discussion centered on how properly to define the term "quality control"—and how best to fit its function into a given organization. "And that's different from the QC panel of five years ago," remarked one production executive who had attended both. "Then the talk was entirely of mechanical techniques and mathematical procedures."

Quality Control, many agreed, still has its closest application to the problems of manufacturing. But it is spilling all over the place, some commentators said—even into clerical routines.

Most striking suggestion at the Quality Control session came from a leading authority in the science: "It is quite possible to conceive," he said, "that we might sometime have a rating of various companies on the basis of the quality of their final products, similar to the Dun & Bradstreet financial ratings."

Vendors generally are being evaluated more and more on the quality they produce, it seemed generally agreed. One company, it was reported, makes a practice of not paying its invoices until a machine tool has proved out its vendors' promises in terms of quality control experience.

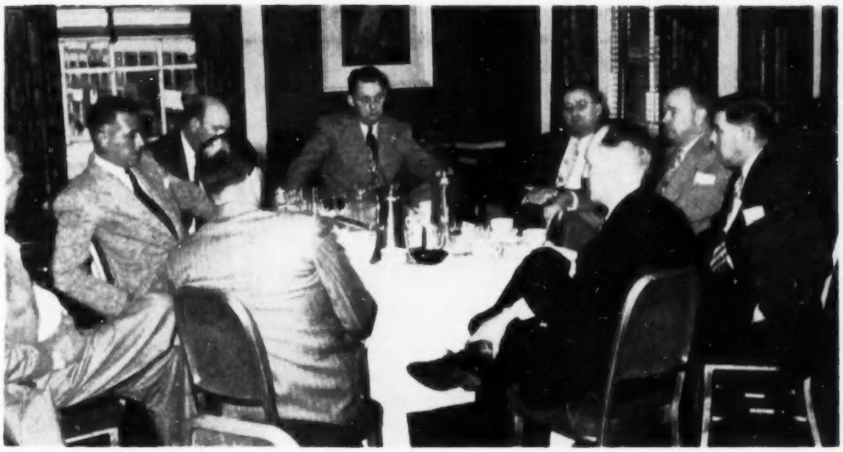
Case histories at the Grinding and Cutting Tools session centered around experiences with CO_2 and other new types of coolant, on new methods of fabricating carbides, and on new methods of prolonging tool life.

The Preventive Maintenance session heard detailed, practical descriptions of several PM control operations in which standards have been set up to cover almost every phase of the factory operation. It got copies of one complete manual for further study. And it learned that one company insists on replacing a bearing in a machine when required by its PM standard even if the bearing isn't worn out—and why.

Production Control

Forum Scores Again

PRODUCTION TOMORROW



Lots of pretty useful information came out of the spirited give-and-take discussion at the eight panel sessions. That's what General Chairman Paul Miller (extreme right) and his panel leaders reported at their "kaffee klatsch" get-together immediately following the Production Forum

The Foundry session voiced a strong desire for foundrymen to get more direct contacts with engineers of the companies for whom they are producing. Better work could be done more economically, they insist, if they get better "practical" specifications, know more regularly just where very close tolerances are actually required. . . . Shell molding got a good going-over at this session, too. Foundrymen exchanged data on what actually happens in application of shell molding to specific pieces. One thing all seemed to agree on: Shell molding has awakened the whole foundry industry to development of better techniques in green sand and other molding processes. "The foundry industry is on the threshold of startling developments in the fundamentals of its existing techniques," one leading foundryman predicted.

New developments in palleting and in most effective use of fork trucks and tote pans were among the many specific problems taken up at the Materials Handling session. Growing use of fork trucks equipped with devices to permit radio control was noted. Many plants, it was said, now route fork trucks from a central radio-control booth as taxicab companies have been routing their cabs in increasing numbers recently.

But at this session, too, the personnel phase was touched on specifically. Management, it was reported, is more and more seeing materials handling training as a good basis for upgrading an engineer in its manufacturing force.

Customer relations got their best work out at the Production Control session. "Never promise a customer a schedule that you know you can't meet" was an expressed dictum to which many agreed. . . . And, here again, great advantages were envisioned from closer, direct contact between production men in supply companies and engineers and technicians in the customer's plant. Controls and scheduling, it was urged, must be developed by each supplier organization to meet its own particular requirements —in relation to those of the particular customer.

In the meantime, all of these reports have been multiticles based on the reports of the secretaries of each of these Forum sessions. These articles will bring out many of the specific experiences which were related, the questions which were asked and answered, the concensus of opinions that seem to evolve from the discussions.

In the meantime, all of these reports have been multilithographed and combined as an SAE Special Publication—SP301. SP301 is available right now to SAE members for \$1.50 and to nonmembers for \$3.00.

Materials Handling

Quality Control

CHIPS

Courtesy of "American Machinist"

LABORATORY tests show that a better finish will result in superior service. However, in production, where working environment frequently deviates from that envisioned by the engineer, and thermal distortion is possible, a surface rougher than that specified may be an asset in that rapid preliminary wear will smooth mating surfaces and effect closer fit. But, it was pointed out, mating parts with too rough a finish may be "worn out before they are worn in"—so careful judgment is necessary.

The consensus was that finish should carry a tolerance just as do print dimensions, and the engineer might well develop a plus-or-minus factor by setting up coordinates and giving allowable finish tolerances in two dimensions. This two-way tolerance guide would be especially advantageous where stress-raiser conditions are encountered.

How best to obtain the required finish, it was agreed, still is a major problem. While many methods will achieve the finish desired by the engineer, it is, in a number of cases, not possible to "sell" the indicated method to inspection. As an example of this problem, one airframe manufacturer finds inspection willing to approve shot peening or sandblasting for planes classed as expendable, while rejecting similarly finished parts for craft not so classified.

While a thermoplastic finish problem was solved by first machining the part, then heating it to 140 F and "ironing out the wrinkles," manufacturers of phenolic parts are returning to the old principle of burnishing in an effort to achieve satisfactory finishes.

For general work, grinding, scraping, vapor blast, and liquid honing were suggested as acceptable methods of finishing where applicable.

As an aid to inspection, a small portable profilometer now is in the pilot production stage and will be available shortly. This device may be used to check parts in process without removing them from the lathe, grinder, or other machine.

A magnetic probe finish inspection development, it was said, is especially advantageous for checking both magnetic and non-magnetic materials. In this device, a reading is automatically recorded on a strip chart.

Tapping

It was agreed emphatically that the design engineer could reduce tapping problems substantially by making all possible allowances on thread and pitch, by allowing through holes where possible, and by making greater allowance for chip clearance in blind holes.

A problem was presented where deep hole drilling and tapping must be accomplished without use of standard coolants because adjacent workpiece material could not be cooled. It was suggested that a fine stream of air or carbon dioxide under high pressure directed at the tool might solve the problem. Also attention was directed to a novel pres-

PRODUCTION TOMORROW

. . . from the Machining Panel

H. W. Ingalls, Solar Aircraft Co.

Report of Panel on Machining held as part of the Aeronautic Production Forum at the SAE National Aeronautic Meeting, Los Angeles, Oct. 1, 1952. Leader was K. W. Stalker, Aircraft Gas Turbine Divisions, General Electric Co.

sure-controlled head which is set to feed at a predetermined rate under constant pressure. When more pressure is required to advance the drill or tap, an automatic reaction removes the tool to allow cooling.

Carbon dioxide as a coolant is almost mandatory in drilling and tapping titanium.

To the question of how to avoid hilation (the marking of the workpiece where the tap stops), especially in taper tapping aluminum, it was suggested a regular steel drawing oil be used as lubricant, or that a lead screw be used to reduce the mark. Careful grinding of the offending flute also will minimize this defect.

Although severely close tolerances cannot be met, the Machining "X" method, which uses a net tap and an electrostatic procedure, was recommended as worthy of investigation for problems involving the tapping of especially hard materials.

Following the regrinding of taps, longer life is achieved by liquid honing. In fact, some companies use this procedure on all new taps and are realizing faster tapping and longer tool life.

Three-Dimensional Machining

Use of two-dimensional controls to achieve successful three-dimensional milling was announced by one panel member, who outlined a system of mounting the workpiece on a rocker fixture and cam to develop a helix over a 7-ft route. Although tooling costs run to $2000 or $3000, the system reduces machine and hand operations substantially and has proved worth while for production runs.

The system is applicable only where the workpiece presents a single flat surface, and would be unsatisfactory for such geometry as propeller blades and the like.

Helical Carbide Cutters

Several carbide companies are now twisting carbide blocks or strips to meet requirements of industry. (Formerly the straight blanks only were available. The purchaser had to obtain the desired helix either with vise, pliers, and an acetylene torch, or through induction heating to a maximum of 2200-2300 F and a mechanical twisting setup.)

The formed carbide blank can readily be silver soldered into position, preferably with a 10-deg positive rake. A positive rake angle of as much as 40 deg has been used experimentally with excellent results in speed of feed and accuracy of finish.

One airframe company has developed an entire series of helical carbide cutters and is a strong advocate of their advantages, although all possibilities have not yet been explored.

It was indicated that adequate supplies of cutting blanks are obtainable for as little as $30 each. They can be used with standard arbors to solve many cutting and milling problems. Sharpening is completed by first grinding the face, then the outside diameter. If silver solder is used to attach the carbides, it can easily be melted with no deleterious effects to the cutting strip, which then can be used for other applications.

Balance is important for satisfactory performance. While these cutters are excellent for micarta and phenolics, they also give highly satisfactory results in many more difficult applications. For ex-

ample, a 4-in. cutter taking a rough cut in SAE 4130 steel heat-treated to 180,000-200,000 psi, performs well at 40 surface feet per minute.

Although no data are available, it was suggested that a herringbone setup of crossed flutes might prove effective in reducing thrust values.

Foreign Machine Tools

Although an organization has been set up to develop minimum standards for acceptable foreign machine tools, at present there is a certain amount of gamble in purchasing such machines.

While some machines from France, Italy, Switzerland, and Western Germany feature strong, rugged construction, others are too light for production and need "beefing up." In some cases chucks and other machine attachments are inaccurately made, and some machines are indexed in the metric system, making them practically worthless in this country. Many foreign companies gained a foothold here by providing prompt delivery of machines; however, as time progresses it is becoming more and more apparent that their delivery dates are now slipping back to the point where delivery on those machines in popular demand is comparable with that of American manufacturers in many cases. It was further indicated that in some instances replacement parts will be either unavailable or at best slow in arrival.

Special Machines

Because there is a growing trend toward specialized machine tools, airframe and aircraft parts manufacturers are experiencing difficulty in obtaining deliveries. More and more companies are designing tools for special applications. In some instances they are finding it expedient to construct the tools themselves because machine builders hesitate to break into runs of standard machines to gamble on possible losses on the special devices.

Although upon occasion engineering changes have made special machines obsolete even before parts were produced, in most cases slight rework will salvage such a tool for other applications. It was agreed that the over-all picture favors special machine tools.

Participants deplored the laxity of machine tool manufacturers in meeting their commitments for replacement of broken or worn out parts. A number of men in attendance were particularly concerned with the laxity and unconcern on the part of local manufacturers' representatives. Many were recommending that the best results could be obtained by bypassing the local representatives entirely and dealing directly with the factory, as do many manufacturing plants of the Midwest and East. But one man reminded his listeners that there are some exceptions—some dealers and manufacturers' agents who try very hard to do a good job for West Coast manufacturers.

Control of Setup Costs for Minimum Runs

A system of analysis sheets and setup boxes was offered as a cost saver for minimum runs. The analysis sheet calls out all tooling necessary for the job and indicates all operations in sequence, giving cutting speeds, depth of cuts, and other pertinent data. Special tools are maintained in the setup box and standard tools are added by the tool crib attendant.

When the run is completed, additions are made on the sheet, either approving the tooling for subsequent runs or noting need for regrind, replacement, or other necessary tooling correction.

It was agreed that a duplicating machine can be used for operations other than profiling to cut short-run costs, although the consensus was that a standard machine will turn out more work to closer tolerances if an experienced machinist is running it.

Time can be saved where prints are complex by having engineering or tool design develop rough-cut prints, or sketches.

During the discussion it was agreed that machine manufacturers could develop greatly improved duplicators.

H. W. Ingalls (left) wrote the accompanying report of the discussion led by his colleagues at the table. They are, after Ingalls of Solar, C. R. Lewis of Chrysler, Panel Co-Leader J. A. Logan of Solar, Panel Leader R. A. Willsey of Solar, W. A. Nordhoff of Douglas, Glynn Williams of Axelson Manufacturing, and Willard France of Boeing

NEWS

OF

SAE

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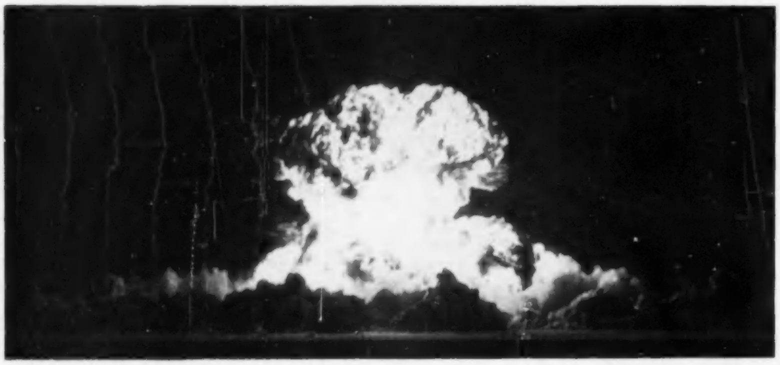


YUCCA FLATS . . .

. . . A-bomb test and its effects on cars will be described at Summer Meeting.

JUST what does happen to a passenger car when it bucks the unleashed fury of an atom bomb? The first-hand answer to this one will be reported to SAE at the Summer Meeting by two of the top men at the Yucca Flats atom bomb test last March.

A pretty thorough evaluation of just how well the 50 cars at Yucca Flats withstood the A-bomb blast will be presented by A. L. Haynes, Ford Motor Co. Haynes was chairman of the SAE committee that advised the Federal Civil Defense Administration on operation of the test. Chairman of the session will be H. L. Goodwin, FCDA's director of the atomic test operations staff.

Haynes will supplement his talk with a display of some six of the cars that lived through the atomic tempest. He and his committee members helped set up the car tests and then gave the cars a thorough going-over after the big blast. Here are some of the questions Haynes will answer in his talk:

- How much damage is done to a car at various distances from dead center of the blast?
- What is the effect of radiation on car components?
- Is there less damage with the windows opened than closed?
- Can the tires, engine, and body withstand the blast?
- Will the car interior offer any protection to people in case of an A-bomb attack?

Haynes will bring to light these and many other interesting points in his talk "The Postwar Car and the A-Blast—What Are the Odds?" to be presented at the Tuesday night session on June 9. The session is sponsored by the SAE Body Activity.

Canadians Convene at Cleveland

FEW appreciate the energies, efforts, and manhours that go into planning and completing the program for an SAE meeting. A case in point is the operations of the SAE Canadian Section in preparing for the SAE International Production Meeting in Toronto, October 29-30, 1953.

Preparations for this meeting have been under way for more than a year. Its planners and participants have been attending meetings of the SAE Production Activity Committee, attending other SAE national meetings and Production Forums, contacting production men in Canadian industry, and holding meetings of their own.

Shown above are some of these men who came to the SAE National Production Meeting in Cleveland to observe, evaluate, and apply the features of that meeting. At the head of the table in the photo at left are Neil P. Petersen, SAE Vice President for Production (left), and Malcolm Jolley, general chairman of the Production Forum of the International Production Meeting.

Others in the group above are R. W. Richards, general chairman of the Meeting and panel leaders of seven of the eight Production Forum panels. They are: J. R. Mott, chief metallurgist, Canadian Acme Screw & Gear Co., Ltd.; J. Clayton Knapp, Ford Motor Co. of Canada, Ltd.; Ed Barker, Modern Tool Works, Ltd.; J. G. Craig, Chrysler Corp. of Canada Ltd.; A. W. Hollar, Dominion Forge & Stampings Ltd.; A. A. Scarlett, International Harvester Co. of Canada Ltd.; and Mr. McMurray, General Motors of Canada, Ltd. Present too was George R. Jackson, chairman of the publicity committee.

ARCTIC FLIGHTS . . .

. . . and associated ground operations will be studied in a three-session symposium at Summer Meeting.

A SYMPOSIUM on Arctic problems related to aircraft will occupy the last two days of SAE Summer Meeting, June 11 and 12 at Atlantic City. A. E. Lombard, Jr., of the USAF's directorate of research and development, is the general chairman.

The three SAE Activities sponsoring the symposium are planning it to be of interest to both military and commercial operators.

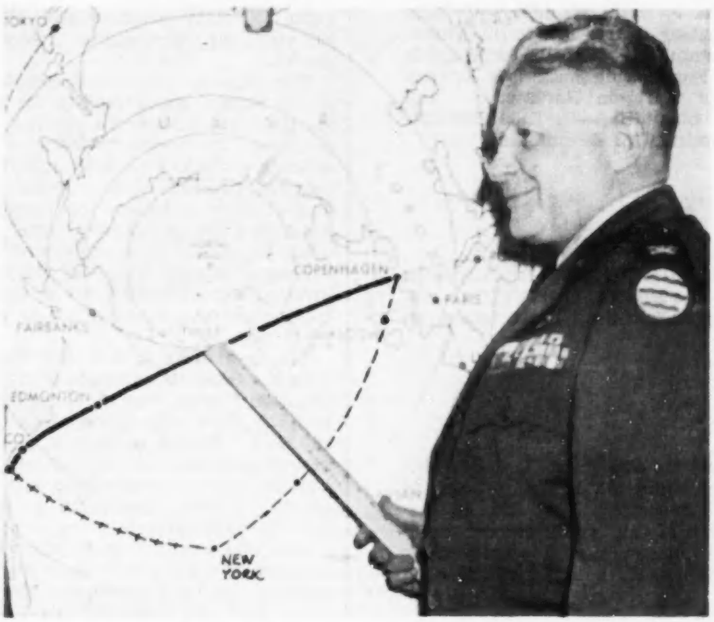
That the North Pole will be the focus of World War III General "Hap" Arnold predicted years ago. Col. Bernt Balchen, who is to be one of the symposium speakers, recalled Arnold's prediction recently in an interview in New York and reconfirmed it. He pointed out that nearly all the strategically important targets are in the northern hemisphere. From a mental picture of a string and a globe, it's easy to understand why the shortest routes between major intercontinental targets pass through Arctic regions.

The shorter routes make Arctic flying of interest to commercial operators also. Already Scandinavian Airlines System has made an experimental flight from the West Coast to Denmark. An SAS plane, with Balchen aboard, flew from Los Angeles to San Francisco, Edmonton, Thule, and Copenhagen last fall. The Arctic route saves 1400 miles over the West Coast-Scandinavia route via New York.

Of course, as soon as aviation experts think of regular Arctic flights, they want to consider special cold-weather routines and emergency provisions, Lombard and his program planners figured. So the Thursday morning session will take up, besides the SAE flight, reports on the Arctic environment and how to exist there by Paul Siple of the Army's G-4 Research and Development Division and Lt.-Col. J. O. Fletcher of the Fourth Air Weather Group. The Friday morning session will go into aircraft maintenance and starting in the Arctic. Col. A. E. Krieger, Jr., of Ladd Air Force Base in Alaska will discuss low-temperature maintenance problems. Frank Carroll, Jr., will report on deaerating cold-weather oil systems and Everett Rowland will talk about hot fuel priming for starting. Carroll is with United Aircraft Products and Rowland is with the Wright Air Development Center. H. C. Mougey and Kenneth Boldt of the CRC Group on Lubricant Requirements Under Arctic Temperatures will report on that Group's work.

Emergency operations will be Brig.-Gen. T. J. DuBose's topic on the Thursday evening program, which he will share with Colonel Balchen. DuBose will discuss world-wide—including Arctic—operations of the Air Rescue Service, of which he is commanding general.

Chairmen for the three sessions are A. L. Washburn, a consultant on Arctic problems; Harold R. Harris, president of Northwest Airlines; and Col. A. C. McKinley, technical assistant to the chief of Naval operations for polar projects. Session secretaries will be J. E. Gillis, Jr., of the Snow, Ice, and Permafrost Research Establishment, Frank Lord of Northwest Airlines, and Major B. A. Goewey of the U. S. Marines.



Col. Bernt Balchen shows on the map why the Arctic route from the West Coast to Scandinavia is so much shorter than the route via New York. Balchen will participate in the two-day symposium on Arctic problems related to aviation at the SAE Summer Meeting in Atlantic City

DIESEL . . .

. . . Activity plans review of European Diesels at Summer Meeting.

EUROPEAN diesel engines—both on the Continent and in England—will get a thorough going over at the 1953 SAE Summer Meeting, according to plans being laid by the SAE Diesel Engine Activity.

P. H. Schweitzer of the Pennsylvania State College and C. G. A. Rosen of Caterpillar Tractor Co. are collaborating on a paper that will describe and evaluate noteworthy developments in small 2-stroke diesel engines in Europe. Particular attention will be paid to the uniflow and the loop-scavenged engines, which are becoming so popular in Europe. Included also will be material gathered by Schweitzer during his recent tour of European plants. Rosen will present the paper.

Latest developments in the United Kingdom in regard to high-output diesel engines for automotive applications will be contained in another paper to be presented at the same session. Its authors will be P. W. Bedale and C. G. Williams of the Shell Laboratories in England. The paper will contain important information on the supercharging of high-output diesels. Bedale will make a special trip to this country to present the paper.

In addition, the Diesel Engine Activity has planned two **round tables**, each with a panel of experts, as follows:

1. "Cast-in Groove Inserts as a Solution to the Groove Wear Problem."

You'll Be Interested to Know . . .

CENTRAL ILLINOIS SECTION has had its territory extended to include the Illinois counties of Piatt and Champaign. . . . That puts the Unviersity of Illinois in Central Illinois Section territory and gives SAE's active student Branch there additional backing. (These two counties are not contiguous to any other Section territory.)

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SAE COUNCIL HAS APPPROVED amendments needed to make the Society's By-Laws conform with recently adopted amendments to the Constitution. In addition, a number of clarifying and simplifying amendments were adopted.

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R. P. KROON of Westinghouse Electric has been appointed SAE's representative on the Daniel Guggenheim Medal Board of Award for a three-year term beginning Oct. 1, 1953. W. G. LUNDQUIST of Wright Aero is currently SAE representative on this Board. His term expires as Kroon's begins.

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ADDITIONAL APPOINTMENTS TO SAE ACTIVITY COMMITTEES have been made by the respective SAE Vice-Presidents as follows: to the Diesel Engine Activity Committee—M. A. PINNEY of Pennsylvania R.R. . . . to the Tractor & Farm Machinery Activity Committee—D. ROY HORNELL of Massey-Harris . . . to the Transportation & Maintenance Activity Committee—GEORGE FEHLNER of Redifer Bus System . . . to the Engineering Materials Activity Committee—PHILIP S. ROGERS of Harrison Radiator . . . and to the Aircraft Powerplant Activity Committee—E. J. MANGANIELLO of the National Advisory Committee for Aeronautics.

• • • •

A REGIONAL VICE-CHAIRMAN REPRESENTING ROCHESTER has been approved as an addition to the BUFFALO SECTION's role of officers. Some 50 members of the Buffalo Section are located in the vicinity of Rochester.

• • • •

IN 1954, according to Meetings Committee Chairman H. E. CHESEBROUGH, SAE's Passenger Car, Body, and Materials Meeting will be shifted to the Hotel Statler—still in Detroit. The Statler, veterans recalled, was the site of the first of the "passenger car meetings" held by SAE, when the chief dinner speaker was the famous GEN. HUGH "IRON PANTS" JOHNSON, then keeper of the NRA Blue Eagle.

A. M. Brenneke, Perfect Circle Co., will be leader of the panel that will discuss various phases of this subject. Other panel members will be: R. S. Frank, Caterpillar Tractor Co.; Ray Sulprizio, United Engine & Machine Co.; Fred Zollner, Zollner Machine Works; G. T. Ladd, Al-Fin Division, Fairchild Engine & Airplane Corp.; and J. M. Smith, Aluminum Co. of America.

2. **"Diesel Exhaust Valve Problems Associated with Fuels and Lubricants."** H. V. Nutt, U. S. Naval Engineering Experiment Station, will be leader of this panel. Other members will be: Hans Gadebusch, Detroit Diesel-Engine Division, GMC; Leonard Raymond, Socony-Vacuum Oil Co.; R. A. Pejeau, Cleveland Diesel-Engine Division, GMC; C. C. Moore, Union Oil Co. of Calif., and others.

TURBINE . . .

. . . and jet testing facility of Navy is to be open to 200 SAE visitors on June 10.

THE U.S. Naval Air Turbine Test Station at West Trenton, N. J. has invited 200 SAE members and friends to visit on Wednesday afternoon, June 10.

This Station, now almost completed, is the Navy's prime facility for testing turbojets, turboprops, ramjets, and pulsejets. It consists basically of two altitude chambers for testing turbojet engines, two sea-level cells for jets, one altitude chamber for turboprop tests; and associated ram-blower machinery, refrigeration equipment, and exhauster equipment. The Navy has invested almost $30,000,000 in the facility since construction began three years ago.

People wishing to tour the Station with the SAE group should secure application blanks from SAE headquarters, 29 West 39th Street, New York 18, N. Y. Blanks should be filled in and returned to SAE by May 20. The Station can accommodate only 200 guests, so SAE can accept only the first 200 applications.

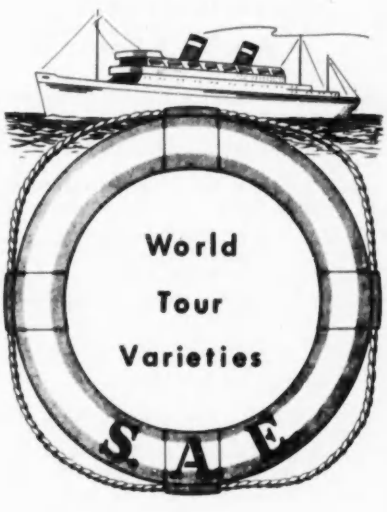
The tour is timed to be convenient for members and guests at or on their way to the SAE Summer Meeting, June 8-12, at Atlantic City. West Trenton is only 73 miles away, and train service between the two points is excellent. The tour is to begin at 1:30 p.m. and last about 2 hours.

FREE . . .

. . . tour of the world's nightlife centers. This can be yours at the Summer Meeting.

DO YOU yearn to witness a sensational performance of the cancan in Paris' famous Folies Bergere? Hear haunting Viennese melodies and see amazing acrobatics performed in a Bavarian tavern? Visit fabulous Casablanca and be beguiled by a swami from the Far East? Tarry a while in the city of exciting dances—Havana —and watch Latins do the rhumba and the samba?

If you have a passion to visit these gay nightlife centers of the world— and who doesn't—then you'll want to be at the SAE Summer Meeting for sure! For on Wednesday night, June 10, the good ship "Relaxation" casts off for SAE's World Tour Varieties. And Paris, Casablanca, Cuba, and Vienna are just a few of the ports of call on tap.



To complete your tour in style, your tourist agency suggests that you come in costume. So choose your favorite country—any nation will do—and be ready to board the Relaxation in costume when the bells ring and the horns blow after dinner on June 10. (Don't worry, you'll still be welcomed if you can't come dressed in foreign duds.)

The important thing is to be there! For if you think the Country Carnival and Gaslight Gayeties held at previous Summer Meetings were good, "You ain't seen nothin' yet!" You especially won't want to miss the spectacular "Parade of the Nations" which will be the climax to your trip.

And when it's all over, you'll undoubtedly want to tip your hat to the best tourist agency yet—Mr. and Mrs. R. F. Steeneck, Mr. and Mrs. J. E. Cole, Mr. and Mrs. R. Wayne Goodale, Mr. and Mrs. Robert B. Hawkins, Mr. and Mrs. H. O. Johnson, Mr. and Mrs. R. I. Potter, Mr. and Mrs. Raymond A. Snyder, and Mr. and Mrs. W. K. Creson.

National Meetings . . .

Meeting	Date	Hotel
	1953	
SUMMER	June 7-12	The Ambassador and Ritz-Carlton Atlantic City, N. J.
INTERNATIONAL WEST COAST	Aug. 17-19	Georgia Hotel, Vancouver, B. C.
TRACTOR and PRODUCTION FORUM	Sept. 14-17	Hotel Schroeder, Milwaukee
AERONAUTIC MEETING and AIRCRAFT ENGINEERING DISPLAY and AIRCRAFT PRODUCTION FORUM	Sept. 29-Oct. 3	Hotel Statler, Los Angeles
INTERNATIONAL PRODUCTION	Oct. 29-30	Royal York Hotel, Toronto
TRANSPORTATION	Nov. 2-4	Conrad Hilton, Chicago
DIESEL ENGINE	Nov. 3-4	Conrad Hilton, Chicago
FUELS & LUBRICANTS	Nov. 5-6	Conrad Hilton, Chicago
	1954	
ANNUAL and ENGINEERING DISPLAY	Jan. 11-15	The Sheraton-Cadillac and Hotel Statler, Detroit
PASSENGER CAR, BODY, and MATERIALS	March 2-4	Hotel Statler, Detroit

Program for

SAE Summer Meeting

The Ambassador and Ritz-Carlton
Atlantic City, N. J.
June 7-12, 1953

ALL EVENTS AT THE AMBASSADOR UNLESS OTHERWISE NOTED

Lounge, Venetian and Renaissance Rooms on Mezzanine Floor; Rooms 100-125 on First Floor.

Sunday, June 7

8:30 p.m. **Lounge**

Reception-Get-Together

Monday, June 8

9:30 a.m. **Venetian Room**

Chairman—**H. J. Fischbeck,** Pratt & Whitney Aircraft, Div. of United Aircraft Corp.

Secretary—**W. E. Ellis,** Timken Roller Bearing Co.

Symposium—Corrosion Prevention During Processing, Storage, and Shipment

Automotive Application
C. O. Durbin, Chrysler Corp.
With automotive parts, corrosion-prevention begins during manufacture and continues through shipping and storage. Knowledge of potential sources of corrosion and of preventive methods is essential.

Corrosion Control in Military Packaging
G. S. Mustin, Bureau of Aeronautics, Navy Department
Since packages can hold the fate of national security, corrosion control assumes top importance. Industry is invited to consider the requirements of military packaging.

(Sponsored by Engineering Materials Activity)

2:00 p.m. **Room 105**

Round Table—Pros and Cons of Door Constructions
Leader:
R. O. Doss, Fisher Body Div., General Motors Corp.
Secretary:
E. R. Ziegler, Ainsworth Manufacturing Corp.
Panel Members:
H. A. Bolenski, General Motors Corp.
Frank Nemeth, Studebaker Corp.
L. H. Nagler, Nash Motors Div., Nash-Kelvinator Corp.
(Sponsored by Body Activity)

2:00 p.m. **Room 125**

Round Table—Instrumentation and Evaluation of Riding Comfort
Leader:
A. C. Bodeau, Ford Motor Co.
Secretary:
B. E. O'Connor, Houdaille-Hershey Corp.
Panel Members:
Noise Measurements—**D. C. Apps,** Proving Ground, General Motors Corp.
R. D. Evans, Goodyear Tire and Rubber Co.
M. P. Hershey, Firestone Tire and Rubber Co.
Vibration and Ride Measurements—**Norris March,** Chrysler Corp.
A. K. Simons, Bostrom Manufacturing Co.
F. F. Kishline, Nash Motors Div., Nash-Kelvinator Corp.
Handling and Performance Measurements—**W. A. McConnell,** Ford Motor Co.
Automotive Telemetering—**T. E. Stewart,** Electro-Mechanical Research, Inc.
(Sponsored by Passenger Car Activity)

8:30 p.m. **Venetian Room**

Chairman—**P. H. Pretz,** Ford Motor Co.
Secretary—**W. A. McConnell,** Ford Motor Co.

Panel Meeting — Linkage-Type Power Steering
Panel Members:
W. K. Creson, Ross Gear & Tool Co.
C. W. Lincoln, Saginaw Steering Gear Div., General Motors Corp.
C. F. Hammond, Gemmer Manufacturing Co.
T. H. Thomas, Bendix Products Div., Bendix Aviation Corp.
C. J. Smith, Monroe Auto Equipment Co.
(Sponsored by Passenger Car Activity)

Tuesday, June 9

9:30 a.m. **Venetian Room**

Chairman—**S. J. Tompkins,** Chrysler Corp.

Secretary—**K. W. Gordon,** Chrysler Corp.

Does the Public Benefit from Size and and Weight Restrictions?
M. C. Horine, Mack Manufacturing Corp.
Size and weight restrictions were imposed when the highway system was less adequate, safety only an ideal, the economics of highway transportation little understood, and roads were regarded as recreational facilities. Things have changed!
(Sponsored by Truck and Bus Activity)

2:00 p.m. **Room 125**

Round Table—Automotive Seating—Testing and Evaluation by Instrumentation
Leader:
J. C. Gordon, Gordon-Chapman Co.
Secretary:
V. A. Buck, Chrysler Corp.
Panel Members:
R. N. Janeway, Chrysler Corp.
Arthur Bassette, Fisher Body Div., General Motors Corp.
E. C. Pickard, Ford Motor Co.
W. E. Lay, University of Michigan
(Sponsored by Body Activity)

2:00 p.m. **Room 105**

Round Table—Plastics as Automotive Engineering Materials
Leader:
C. F. Nixon, General Motors Corp.
Secretary:
R. E. Van Deventer, Packard Motor Car Co.
Panel Members:
Decorative Plastics—**J. T. O'Reilly,** Ford Motor Co.
Functional Plastics—**Travis Meister,** Kaizer-Frazer Corp.
Reinforced Plastics in the Automotive Industry—**A. Carter,** Chrysler Corp.
Automotive Uses of Nylon—**Park Woodworth,** E. I. du Pont de Nemours and Co., Inc.
Plastic Dies—**H. D. Thompson,** D. G. Products Corp.
(Sponsored by Engineering Materials Activity)

2:00 p.m. **Venetian Room**

Chairman—**Leonard Raymond,** Socony-Vacuum Oil Co., Inc.
Secretary—**T. B. Rendel,** Shell Oil Co.

Symposium—The New Look in Automotive Laboratory Design

An Automotive Laboratory for Southern California
C. C. Moore, W. L. Kent, and N. G. Allison, Union Oil Co. of California

A Modern Petroleum Test Engine Laboratory
O. G. Lewis, T. W. Osbahr, Jr., and S. C. Sperling, Standard Oil Development Co.

Recent Developments in Engine Instrumentation
J. H. Chandler, Ford Motor Co.

New Tools for Research on Fuels and Lubricants
J. B. Duckworth, W. W. Frank, and J. H. Schruben, Standard Oil Co. (Indiana)

An All-Weather Chassis Dynamometer
B. W. Moore, J. H. Macpherson, Jr., and V. C. Davis, California Research Corp.

Some Design Features of the Sinclair Engine Laboratory
M. L. Hamilton, Sinclair Research Laboratories, Inc.

A New Look to an Old Laboratory
F. H. Caudel, Shell Oil Co.

(Sponsored by Fuels and Lubricants Activity)

2:00 p.m. **Room 125**

Round Table—Prospects for Better Passenger Car Brakes
Leader:
A. E. Kimberly, Chrysler Corp.
Secretary:
W. R. Rodger, Chrysler Corp.
Panel Members:
N. L. Blume, Ford Motor Co.

A. J. Burkman, General Motors Corp.
D. P. Dyer, Budd Co.
A. C. Gunsaulus, Goodyear Aircraft Co.
C. T. Ladd, Al-Fin Div., Fairchild Engine and Airplane Co.
A. C. Sampietro, Willys-Overland Motors, Inc.
T. H. Thomas, Bendix Products Div., Bendix Aviation Corp.
(Sponsored by Passenger Car Activity)

2:00 p.m. **Room 105**

Round Table—The Education, Development, and Future of the Motor Transportation Executive
Leader:
E. P. Gohn, Atlantic Refining Co.
Secretary:
Henry Jennings, Fleet Owner
Panel Members:
Robert Gardner, Lever Brothers Co.
J. W. Lord, Atlantic Refining Co.
T. L. Preble, Tidewater Associated Oil Co.
H. G. Steigerwalt, Supplee-Wills-Jones Milk Co.
H. L. Willett, Jr., Willett and Co.
(Sponsored by Transportation and Maintenance Activity)

8:30 p.m. **Venetian Room**

Chairman—**H. L. Goodwin**,
Director, Atomic Test Operations Staff, Federal Civil Defense Administration
The Post-War Car and the A-Blast—What Are the Odds?
(Report of the **SAE-FCDA Advisory Committee**)
To be presented by **A. L. Haynes**, Ford Motor Co.—Committee Chairman
Display of Test Cars
(Sponsored by Body Activity)

Wednesday, June 10

9:30 a.m. **Venetian Room**

Chairman—**W. E. Thill**,
Federal Mogul Corp.
Secretary—**F. K. Seydler**
National Carbon Co.

Advantages and Disadvantages of Hydramatic Transmissions in Truck Operations—Economics, Weight, Maintenance, and Relationship to Drivers' Problems
W. W. Edwards, GMC Truck and Coach Div., General Motors Corp.
Automatic transmissions have made operations easier for passengers cars, with desirable by-product results which suggest the wisdom of considering applications to commercial vehicles.

Advantages and Disadvantages of Torque Converter Type Transmissions for Medium and Heavy-Duty Trucks and Tractors in Both Multiple-Stop and Long-Distance Operation
P. L. Gillan and W. S. Coleman, The White Motor Co.
Antithetic operating conditions—high speeds, heavy loads, long runs, frequent stops—create new and difficult operating requirements for transmissions. Advantages and disadvantages of each design must be known and weighed.

(Sponsored by Transportation and Maintenance Activity)

1:00 p.m. **Club 22, Lobby Floor**

Chairman—**Lloyd Withrow**,
Research Laboratories Div.,
General Motors Corp.

Secretary:
J. H. Macpherson, California Research Corp.

Symposium on Preignition

Uncontrolled Combustion in Spark Ignition Engines
S. D. Heron, Ethyl Corp.

An Investigation of Preignition in Engines
A. O. Melby, D. R. Diggs, and B. M. Sturgis, E. I. du Pont de Nemours and Co., Inc.

Deposit Induced Ignition—Evaluation in a Laboratory Engine
D. A. Hirschler, J. D. McCullough, and C. A. Hall, Ethyl Corp.

The Occurrence of Preignition in Present-Day Cars in Normal Service
R. F. Winch, Sun Oil Co.

Effects of Fuels and Lubricants on Auto-ignition in Cars on the Road
J. R. Landis and R. K. Williams, Research Laboratories Div., General Motors Corp.

(Sponsored by Fuels and Lubricants Activity)

2:00 p.m. **Room 122**

Round Table—Cast-In Groove Inserts as a Solution to the Groove Wear Problem
Leader:
A. M. Brenneke, Perfect Circle Co.
Secretary:
J. W. Pennington, Koppers Co.
Panel Members:
R. S. Frank, Caterpillar Tractor Co.
Ray Sulprizio, United Engine and Machine Co.
Malcolm Smith, Zollner Machine Works
C. T. Ladd, Al-Fin Div., Fairchild Engine and Airplane Corp.
J. M. Smith, Aluminum Co. of America
(Sponsored by Diesel Engine Activity)

2:00 p.m. **Room 125**

Round Table—12-Volt Versus 6-Volt Electrical System for Passenger Cars
Leader:
C. W. Rainey, Ford Motor Co.
Secretary:
S. M. Terry, American Bosch Corp.
Panel Members:
Batteries—**L. E. Wells**, Electric Storage Battery Co.
Ignition—**H. L. Hartzell**, Delco-Remy Div., General Motors Corp.
Generators and Starters—**C. R. Boothby**, Electric Auto-Lite Co.
Lighting—**V. J. Roper**, General Electric Co.
Electrical Loads and Accessories—**I. C. McKechnie**, Chrysler Corp.
(Sponsored by Passenger Car Activity)

2:00 p.m. **Room 118**

Round Table—Heat-Absorbing Glass
Leader: **Capt. W. L. Groth**, Safety Engineer, Department of State Police, Virginia.
Secretary: **W. F. Sherman**, Automobile Manufacturers Association
Panel Members:
W. J. Arner, Libbey-Owens-Ford Glass Co.
H. C. Doane, Buick Motor Div., General Motors Corp.
L. W. Parr, Chrysler Corp.
V. J. Roper, General Electric Co.
Ormond Rugg, Ford Motor Co.
R. C. Whittemore, Pittsburgh Plate Glass Co.
(Sponsored by Passenger Car Activity)

2:00 p.m. **Room 105**

Round Table—Tire and Wheel Balance for Longer Tire Life and Easier Steering
Leader: **F. B. Lutz**, Budd Co.
Secretary: **R. W. Wantin**, Ford Motor Co.
Panel Members:
W. E. Shively, Goodyear Tire and Rubber Co.
A. P. Schweizer, Motor Wheel Corp.
J. R. Smith, Metropolitan Transit Authority
(Sponsored by Truck and Bus Activity)

Thursday, June 11

9:30 a.m. **Venetian Room**

Chairman—**F. A. Suess**,
Continental Oil Co.
Secretary—**R. E. Jeffrey**,
Shell Oil Co.
Fuels and Fuel Systems—A Petroleum Viewpoint

T. W. Legatski, O. C. Bridgman, E. W. Aldrich, and R. Rohde, Phillips Petroleum Co.
Newest premise in an old argument: Fuel

Wednesday, June 10

Inspection Trip—U. S. Naval Air Turbine Test Station

West Trenton, New Jersey

The Bureau of Aeronautics, Navy Department, has invited a maximum of 200 SAE members and guests to inspect the U. S. Naval Air Turbine Test Station, West Trenton, N. J., on Wednesday afternoon, June 10, between 1:00 and 3:30 p.m. (EDST).

The inspection has been planned to make it easy for members and guests to participate who either will be attending, or are on their way, to the SAE Summer Meeting. Trenton is only 73 miles from Atlantic City and train and bus service between the two cities is excellent.

This Station is the Navy's prime facility for testing gas-turbine type aircraft powerplants—turbojets, turboprops, ram jets, and pulse jets. Under construction since the Spring of 1949, it is now nearing completion.

The Turbine Test Station consists basically of two altitude chambers for testing turbojet engines; two sea-level cells for turbojets; one altitude chamber for turboprop engine tests; and associated ram-blower machinery, refrigeration equipment, and exhauster equipment. The total investment is approximately $30,000,000.

systems must be modernized to take full advantage of gasoline's increased volatility and higher octane numbers.

What Happens to the Dissolved Water in Aviation Fuels

A. B. Crampton, R. F. Finn, and J. J. Kolfenbach, Standard Oil Development Co.

Dangers from ice forming in aviation fuels and filters may be eliminated, minimized, or reduced by venting. Studies show that water content is curtailed at low humidities and temperatures, and high altitudes.

(Sponsored by Fuels and Lubricants Activity)

9:30 a.m. **Renaissance Room**

Chairman—**T. B. Rendel,** Shell Oil Co.
Secretary—**Howard Hill,** Shell Oil Co.

Whither the European Automotive Diesel?

P. H. Schweitzer, The Pennsylvania State College, and **C. G. A. Rosen,** Caterpillar Tractor Co.

Two-stroke cycle diesels, off to a late start abroad, materialize suddenly in uniflow and loop-scavenged types. Do they signalize the dictates of poverty or progress toward compactness and simplicity?

High Output Diesel Engines in England

P. W. Bedale and C. G. Williams, Shell Laboratories, England

Spurred by shortages and other austerities, British engineers have made progress with automotive-type diesels. Some are supercharged, and all are worth study.

(Sponsored by Diesel Engine Activity)

2:00 p.m. **Room 125**

Round Table—Diesel Exhaust Valve Problems Associated with Fuels and Lubricants

Leader: **H. V. Nutt,** USN Engineering Experiment Station
Secretary, **A. R. Schrader,** USN Engineering Experiment Station
Panel Members:
Hans Gadebusch, Detroit Diesel Engine Div., General Motors Corp.
Leonard Raymond, Socony-Vacuum Oil Co., Inc.
R. A. Pejeau, Cleveland Diesel Engine Div., General Motors Corp.
C. C. Moore, Union Oil Co. of California
W. B. Bassett, Lubrizol Corp.
W. Vollentine, Jr., Caterpillar Tractor Co.
L. A. Wendt, Shell Oil Co.
L. G. Schneider, USN Engineering Experiment Station

(Sponsored by Diesel Engine Activity)

Wednesday, June 10

8:15 p.m. **Renaissance Room**

World Tour Varieties

Our tourists' agency (your Entertainment Committee) has arranged a visit to the gay nightlife centers of the world. Paris (oo! la la!), Vienna, The Riviera, Casablanca, and Cuba are a few of the ports of call scheduled.

To complete the illusion of world travel, your Committee recommends COSTUMES. So, choose your favorite country—any nation will do—and be with us in costume after dinner when the bells ring, horns blow, and the good ship "Relaxation" casts off. Whether in costume or not, you'll be welcome.

Symposium on The Arctic

(Sponsored by Aircraft Powerplant, Aircraft, and Air Transport Activities)

General Chairman—**A. E. Lombard, Jr.,** Directorate of Research and Development, USAF

Thursday, June 11

2:00 p.m. **Venetian Room**

Chairman—**A. L. Washburn,** Consultant
Secretary—**J. E. Gillis, Jr.,** Snow, Ice and Permafrost Research Establishment

The Arctic—Environment and Experiences

The Arctic Environment

P. A. Siple, Research and Development Division, Department of the Army

Vast, primitive, and terrible-temperatured, the strategic Arctic handicaps military operations, yet is no secure defense barrier. Half barren, half forested, practically everything works against practically everybody!

The Airplane and the Arctic Pack

Lt.-Col. J. O. Fletcher, USAF

Airplanes are converting the Arctic wilderness from hostile to hospitable area. Man still cannot travel its surface, but is hurdling its barriers and transforming useless barrens into a useful backyard of civilization.

Over the Top of the World by Commercial Air

Representative of Scandinavian Airlines System (SAS)

8:00 p.m. **Venetian Room**

Chairman—H. R. Harris, President, Northwest Airlines, Inc.
Secretary—Frank Lord, Northwest Airlines, Inc.

The Arctic—Operation

Ground and Air Operation

Col. Bernt Balchen, Deputy Chief of Planning, Arctic Operations, Deputy Chief of Staff, Operations, Hqs., USAF

Necessary to Arctic survival is knowledge. How to provide shelter for personnel and equipment. How to perform useful work. How to adapt men, minds, and materiel to eternal ice, snow, wind, cold, darkness, and discomfort.

The Air Rescue Service—A World-Wide Operation

Brig.-Gen. F. J. DuBose, Commanding General, The Air Rescue Service

Taking as its motto "That Others May Live!", this global unit operates bombers, cargo planes, amphibians, helicopters, and other equipment to aid distressed flying personnel everywhere, any time, under all conditions.

Friday, June 12

9:30 a.m. **Venetian Room**

Chairman—**Col. A. C. McKinley,** Technical Assistant to Chief of Naval Operations for Polar Projects
Secretary—Major B. A. Goewey, USMC

The Arctic—Aircraft Maintenance and Starting

Challenges and Rewards in Alaskan Aircraft Maintenance

Col. A. E. Krieger, Jr., Commanding Officer, 5001st Research and Development Group, Ladd Air Force Base, Alaska

Flying lessons from Alaskan winters, with emphasis upon aircraft and equipment design criteria and maintenance techniques which conquer the handicaps of weathers and temperatures constantly varying between bad and worse.

Deaerating Cold Weather Oil Systems

F. E. Carroll, Jr., United Aircraft Products Co.

Aircraft powerplants can be started at 65-below by using a new oil system which automatically eliminates pre-heating, minimizes oil foaming, segregates diluted and undiluted lubricants. It can be fitted to existing planes.

Hot Fuel Priming Systems for Cold Weather Starting

Everett Rowland, Wright Air Development Center

Hot fuel priming systems send planes up even when temperatures go down to 65-below. Design requirements, test results, advantages.

Report of CRC Group on Lubricant Requirements Under Arctic Temperatures

Crankcase Oils for Use Under Arctic Temperatures

H. C. Mougey, Leader of Group

Experience with Crankcase Oils in Military Ground Vehicles Under Arctic Temperatures

Kenneth Boldt, CRC Observer

Arctic crankcase oils for Army ground vehicles have been developed as a result of CRC and Ordnance Laboratory and field testing from Aberdeen to Alaska. The oils pour from containers and lubricate engines in -65 ambients.

TECHNICAL COMMITTEE *Progress*

Clements Receives Certificate For Service to AMS Division

THE SAE Aeronautical Material Specifications Division took time out at its semi-annual meeting March 16-20 to present Bishop Clements with a certificate honoring him for his 15 years of service to the group.

The occasion marked Clements' retirement from active participation in AMS affairs. He had submitted his resignation to take effect March 31.

In presenting the certificate, AMS Chairman J. B. Johnson recalled that Clements was one of the originators of the AMS movement and served as chairman of the Division in its first years. In recent years he has been chairman of the AMS Division's Carbon and Low Alloy Steels, and Titanium Committee. The certificate read:

> "In acknowledgment of his notable contributions in the Aeronautical Material Specifications Division of SAE, we the undersigned do hereby wish to recognize Bishop Clements, directing particular attention to his outstanding work in the establishment, promotion, and advancement of Aeronautical Material Specifications. His leadership in this activity of the SAE has proven to be of lasting value to all concerned and will stand as a monument for years to come."

J. B. Johnson (left) and Bishop Clements with certificate the AMS Division presented to Clements for "his outstanding work in the establishment, promotion, and advancement of Aeronautical Material Specifications." Johnson, as chairman of the Division, made the presentation. Both Clements and Johnson are wearing United Aircraft guest badges of the Chance Vought plant in Dallas, which the Division visited in the course of its week-long meeting March 16-20.

Johnson made the presentation on Wednesday afternoon, March 18, at the Chance Vought plant, which the AMS members were visiting.

Arrangements had been made to present a testimonial plaque to R. R. Janssen at the same time in gratitude for his work as chairman of the AMS Non-Metallic Materials Committee and for his many other services to the Division. But Janssen could not be present to receive the plaque, and it was mailed to him instead with a special letter from Chairman Johnson.

Janssen is resigning from the AMS Division because of his increased duties as North American Aviation's newly appointed assistant chief research engineer.

Most of the week-long AMS meeting was given over to consideration of proposed new specifications and revisions. The commodity committees met individually Monday, Tuesday, and Thursday. Combined sessions to consider their reports took place on Wednesday and Friday.

One of the many items discussed was the variety of temperatures specified in AMS's for room-temperature and elevated-temperature tests. J. C. Mertz of Pratt & Whitney pointed out that in various specifications 200 F, 200 ± 2 F, 205-210 F, 205-212 F, 210 ± 2 F, 212 F, and 212 ± 2 F are called out. Such slight differences can preclude simultaneous use of one oven for several different tests, making testing more costly. The Division directed commodity committee chairmen to study possibilities of standardizing temperature testing requirements to some extent and to submit recommendations before the next meeting.

The Division plans to meet again the week of September 21-25 in the Boston area.

SAE to Advise USAF on Model Maintenance Shops

WAYS that SAE can help the U.S. Air Force set up model maintenance and repair shops for its huge fleet of commercial vehicles have been crystalized. An exploratory group of fleet operators and USAF representatives suggests that a subcommittee of the T&M Technical Committee be set up to review . . . then advise on the adequacy and suitability of the:

- Air Force's present preventive maintenance program for organizational and field shops. (The organizational level of USAF maintenance and repair includes minor maintenance, such as gas, oil, water, air, and replacement of small components. "Field" covers replacement but not repair of major components.)
- Maintenance equipment for carrying on these operations.
- Layout of this maintenance equipment.

It's all to be part of the USAF's plan to set up efficient pilot maintenance and repair shops that will take advantage of good commercial practice.

The SAE advisory subcommittee will be made up of both fleet operators and makers of typical commercial vehicles that the USAF uses.

New Panel Aims at Standardized Designs For Helicopter Engine-Rotor Connection

STANDARDIZATION of connections between engines and helicopter main rotor drives is the goal of a new joint panel set up by Aircraft Engine Division Committee E-21 and Special Aircraft Projects Division Committee S-2.

Propeller shaft ends of engines designed originally for fixed-wing aircraft are not well suited to helicopters. It will be the new panel's job to investigate the design possibilities and develop recommendations on configurations—probably in the form of one or more SAE Aeronautical Recommended Practices.

For small engines, many helicopter manufacturers prefer flanged engine shafts to conventional externally splined shafts, panel Chairman Miller A. Wachs explained in reviewing the situation at the panel's first meeting. Some smaller engines are coming that way now. Flanged ends are lighter, and they are strong enough for helicopters. (Airplane propellers subject shafts to high gyroscopic loads. But helicopter rotor gyroscopic loads are not transmitted through the transmission. And gyroscopic loads from the helicopter flywheel are relatively minor.)

However, present designs for flanged couplings haven't been entirely satisfactory. Crankshaft end vibration has failed attaching capscrews in fatigue in some cases, Wachs reported.

For larger reciprocating engines, he said, some helicopter manufacturers would like direct-drive nose sections designed especially for helicopters. They feel that such nose sections would be lighter than those they achieve by removing the reduction gears and installing their direct drives. The modified nose sections retain the weight of bearing supports and other structures which would not be present in specially designed noses.

Other manufacturers want a nose section redesigned to provide a mounting pad with a row of studs to which they can attach their own reduction gearbox, Wachs added.

The panel has decided to consider engine-rotor drive connections for three categories of helicopter engines: (1) horizontally opposed engines with displacements up to 900 cu in., (2) radial engines with displacements from 900 to 4360 cu in., and (3) turboprop engines from 150 hp up.

Before attempting to develop designs, the panel intends to ask engine and helicopter manufacturers such questions as:

1. Are conventional external splines, flange-type connections, or internal splines similar to AND 20006 and ARP 277 most suitable in your case?
2. Should provision be made for mounting gearboxes on the engine, even though this would require an additional power take-off for the cooling fan in some instances?
3. Should direct-drive noses be designed specifically for helicopters?

Present at the first meeting of the panel were, besides Wachs of Sikorsky, D. L. Kidd of Aircooled Motors, D. S. King of Lycoming-Spencer, B. Liff of Kaman, R. Moyer of Wright Aeronautical, and N. F. Rooke of Pratt & Whitney. Next meeting is scheduled tentatively for June.

Technishorts . . .

POOL PAINTING KNOWLEDGE—The Organic Coatings Subcommittee is attempting to list paint requirements of various portions of passenger car bodies. Exterior parts are being considered by W. Mitchell of Fisher Body, R. Streeter of Nash-Kelvinator, and R. Wurshing of GM Research. Interior portions have been assigned to F. Anderson of Dodge, J. T. O'Reilley of Ford, and E. Storfer of Chrysler. M. M. Gerson of Ford is chairman of the subcommittee, which comes under the SAE Nonmetallic Materials Committee.

ORDNANCE SPEC POPULAR—MIL-S-11415A (ORD), the specification that ISTC Division II advised on, is being used widely by contractors and arsenals, A. F. Jones of Watertown Arsenal reported at a meeting of the Division. With this new specification ("Steel: Construction Parts for Ordnance Material"), Rock Island Arsenal gets only about one question from a contractor for every 25 they got on the old basis, Jones reported.

Division II is the "Review of Ordnance Specification Division" of the SAE Iron and Steel Technical Committee.

Paul Mozley

C. M. Miller

AMS APPOINTMENTS—Paul Mozley of Lockheed is taking over from Bishop Clements as chairman of the AMS Carbon and Low Alloy Steel, and Titanium Committee. C. E. Carrigan of Fairchild moves into Mozley's former job as committee secretary.

C. M. Miller of Northrop succeeds R. R. Janssen of North American as chairman of the AMS Non-Metallic Materials Committee. F. R. Kostoch replaces Miller as secretary of the committee.

These changes were announced by J. B. Johnson, chairman of the SAE Aeronautical Material Specifications Division.

Clements has retired from active participation in AMS activities. Janssen resigned from the AMS Division because of his increased duties as North American's newly appointed assistant chief research engineer.

Prop Attachment ARP For Turboprops Issued

"ARP 277—Propeller Attachment—Nose Mounted" has been approved and issued. This is the new SAE Aeronautical Recommended Practice covering flange-type attachments for turboprops and their propellers

where the propellers are designed to operate in the 1500–3000 rpm range. It was prepared by a joint panel of SAE Committees E-21 and P-6.

This ARP is unusual in that instead of following established practice, it describes a new design, which the panel worked out specially to meet the new problem of joining 8000–18,000 hp engines to propellers. (By comparison, the largest current piston engine, the R-4360, is rated at 4300 hp.) For higher horsepower powerplants, the conventional splined shaft and cone arrangement is inadequate.

The new design includes (1) a large propeller flange which bolts to a pad on the engine housing and carries the major portion of the loads imposed by the propellers and (2) a spline connection to transmit engine torque. Flange, bolt, and spline dimensions are listed for designs having 22, 26, and 30 in. bolt-circle diameters.

To accommodate eccentricities between mating engine and propeller assemblies, the ARP calls out limit loads and moments which the propeller may apply to the engine spline. As the ARP puts it, "Including the maximum engine shaft eccentricity and misalignment specified herein, and under the conditions of maximum propeller design loading, the forces exerted by the propeller splines on the engine drive splines shall not exceed a side load of 6000 pounds, a fore and aft thrust of 1500 pounds, and a moment of **M**. For normal continuous operation the forces shall not exceed 45% of these specified design values." **M** is 6000 lb-in. for the 22-in. size, 8000 lb-in. for the 26-in. size, and 10,000 lb-in. for the 30-in. size. If necessary to keep the propeller-applied loads within the limits, an arrangement providing flexibility may be incorporated.

Solving the eccentricity problem was one of their major achievements, panel members feel. They believe that the solution they arrived at adds no unnecessary weight, yet insures interchangeability of engines and propellers.

M. E. Cushman of Curtiss-Wright Propeller Division, W. E. Diefenderfer of Hamilton Standard, D. R. Pearl of Hamilton Standard, V. W. Peterson of Allison, N. F. Rooke of Pratt & Whitney Aircraft, E. A. Scordato of Wright Aeronautical, R. F. Schwarzwalder of Wright Aeronautical, and G. R. Taylor of Aeroproducts were members of the joint E-21 and P-6 Panel. Committee E-21 is the Standard Components for Aircraft Engines Committee of the SAE Aeronautics Committee's Engine Division. Committee P-6 is the Propeller Standards Committee of the Propeller Division.

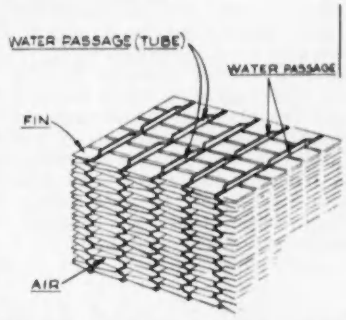
The panel's next task is to draft a similar ARP covering attachments for the larger, lower-rpm propellers now of considerable interest because of their greater efficiency.

Radiator Standard Picturized!

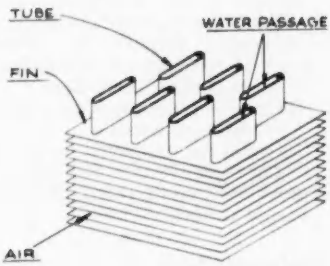
Latest example of the maxim that a picture is worth 10,000 words is the SAE Standard on Radiator Nomenclature.

It has just been revised to include the adjoining descriptive perspective sketches of radiator cores described in the nomenclature. Slight revisions have also been made in the core nomenclature itself.

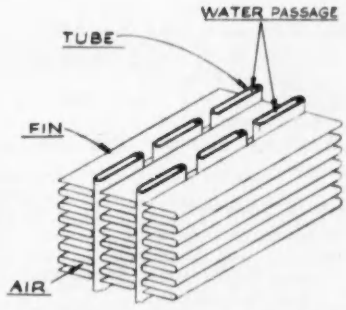
These illustrations should eliminate the possibility of confusing these five basic types of cores, the SAE Truck & Bus Technical Committee believes. They will be published in the 1954 SAE Handbook.



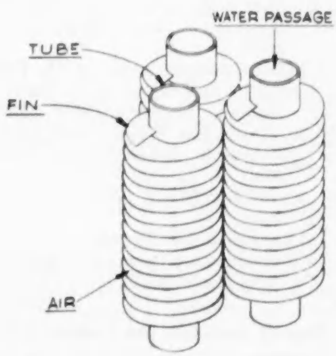
Ribbon Cellular Core—A number of fluid passages made by joining metal ribbons at the edges and grouped to form a cellular structure. Parts of the cellular structure may be of formed or flat ribbon which is not a part of the fluid passages.



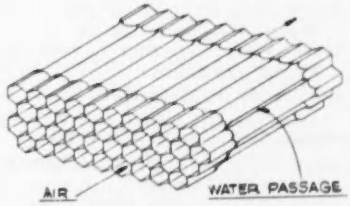
Tube and Plate Fin Core—An assembly of fluid tubes of any cross-sectional form, the tubes being joined together by heat conducting fins or plates common to all tubes or groups of tubes.



Tube and Corrugated Fin Core—An assembly of fluid tubes in line in the direction of airflow and joined in heat transfer relation by corrugated conducting fins inserted between adjacent line of tubes.



Tube and Helical Fin or Tube and Individual Fin Core—An assembly of fluid tubes of any cross-sectional arrangement to each of which are attached gills or fins of circular, square or other shape, each tube and its fin or fins forming a separate unit.



Air Tube Cellular Core—An assembly of air tubes nested in such a way as to form fluid passages between the tubes, the passages being sealed at the ends of the tubes. In this type the fluid may flow transversely as well as vertically around the tubes.

1953 SAE Handbook Out Later This Month

THE 1953 SAE Handbook will go into the mails later this month to the more than 13,300 SAE members who indicated on their dues bills last fall that they wanted the book, and to nonmembers who have ordered it.

This new edition contains all 278 current SAE Standards, SAE Recommended Practices, and SAE General Information Reports approved by the Technical Board through its last meeting in January. Included are the new Crankcase Oil Types, Involute Splines and Serrations Gages and Gaging, Dynamometer Brake Test Code, and the revised Hydraulic Brake Fluid standard. Altogether there are 20 new and 55 revised reports. Their names appear in the accompanying list.

The 1953 Handbook contains 1032 pages. That's 86 pages more than last year's edition. The 1953 book will weigh slightly more than the 1952 book, but will be no thicker because of a change in paper. First and last signatures containing advertisements will be printed by letterpress. The rest of the pages will be photo-offset. Pace Press is doing the job.

SAE ordered 19,000 copies of the 1953 Handbook. As of February, 81% of the people who had paid their 1953 dues had signified that they want the Handbook. Other members may have one free by asking for it. Members may buy additional copies at $5 each. Price to nonmembers is $10.

Reprints of the iron and steel section of the 1953 SAE Handbook will be available to members at $1.50 each and to nonmembers at $3.00. Reprints of the lighting section will be available at 75¢ to members and $1.50 to nonmembers.

New and Revised Reports Appearing in the 1953 SAE Handbook

NEW

Ferrous Metals

Magnetic-Particle Inspection
Carbon and Low-Alloy Steel Investment Castings for Automotive Requirements
Surface-Finish Control

Threads, Fasteners, and Common Parts

Involute Spline and Serration Gages and Gaging
Automotive and General-Service Copper Tube
Hydraulic Flareless Tube Fittings

Electrical Equipment

Breakaway Connector
Ignition-Coil Mounting
Torque Requirements for Spark-Plug Installation
Headlight Testing Machines

Powerplant Components and Accessories

Flywheels for Overcenter Clutches
Diesel-Fuel Injection-Pump Mountings
Diesel-Fuel Injection-Pump Mounting, Flange No. 5
Diesel-Fuel Injection Nozzle-Holder Assemblies
Large-Size Radiator Filler Necks

Passenger Cars, Trucks, and Buses

Color Code for Hydrodynamic-Drive Illustrations
Performance Curve Sheets for Hydrodynamic-Drive Vehicles
Brake Spider Mountings
Brake Test Code—Dynamometer
Ride and Vibration Terminology

REVISED

Ferrous Metals

Chemical Compositions of SAE Carbon Steels
Chemical Compositions of SAE Alloy Steels
General Characteristics and Heat-Treatments of Steels
Estimated Physical Properties of Hot-Rolled and Cold-Finished Carbon Steel Bars
Methods of Determining Hardenability of Steels
Physical Requirements for Bolts, Capscrews, Studs, and Nuts
Cast Shot and Grit for Peening and Cleaning

Nonferrous Metals

Bearing and Bushing Alloys

Nonmetallic Materials

Rubber and Synthetic-Rubber Compounds for Automotive and Aeronautical Applications (SAE 10R)
Classification of Elastomeric Compounds for Automotive Resilient Mountings (SAE 16R)
Latex Foam Rubbers (SAE 17R)
Sponge- and Expanded Cellular-Rubber Products (SAE 18R)
Fuel and Oil Hoses (SAE 30R)
Automotive Brake Hoses (SAE 40R)
Hydraulic-Brake Fluid (SAE 70R)
Crankcase-Oil Types
Transmission- and Axle-Lubricant Classification

Threads, Fasteners, and Common Parts

Screw Threads
Square and Hexagon Bolts and Nuts
Round-Head Bolts
Plain Washers
Ball and Roller Bearings
Automotive Tube Fittings
Hydraulic Flanged Tube, Pipe, and Hose Connections, 4-Bolt Split-Flange Type
Hydraulic Hose and Fittings

Electrical Equipment

Circuit Breakers
Storage Batteries
Starting-Motor and Generator Curves
Magneto Mountings
6- and 12-Volt Cigar-Lighter Switch Bases
Lamp Bulbs and Bases
Lamp Bulbs and Sealed-Beam Units
Lighting Equipment for Motor Vehicles
Color Specification for Electric Lamps
Sealed-Beam Headlamp Units for Motor Vehicles
Electric Supplementary Driving Lamps
Electric Supplementary Passing Lamps
License-Plate Lamps
Turn-Signal Units
Turn-Signal Operating Units
Spot Lamps
Back-Up Lamps
Reflex Lamps
Reflex Reflectors
School-Bus Warning-Signal Lamps
Electric Emergency Lanterns
Liquid-Burning Emergency Flares
Lamps for Aircraft Lighting
Lamps for Airdrome and Airway Lighting

Powerplant Components and Accessories

Engine Flywheel Housing

Passenger Cars, Trucks, and Buses

Brake Linings
Rivets for Brake Linings and Bolts for Brake Blocks

Tractor and Earthmoving Equipment

Agricultural Tractor Drawbars
Yardage Ratings
Air-Cleaner Test Code

New Car Air Cooling Recommendation OK'ed

JUST approved by the Technical Board is a report offering safety practices on passenger compartment cooling systems for automobiles and describing the systems. This is the SAE Recommended Practice on Safety Practices for Mechanical Vapor Compression Refrigeration Equipment or Systems Used to Cool Passenger Compartment of Motor Vehicles.

The safety practices recommended are:

"1. The refrigerant used shall be one of the following:

Carbon dioxide .... CO_2
Dichlorodifluoromethane
(Freon-12) .... CCl_2F_2
Dichloromethane (Carrene No. 1)
(Methylene chloride) .... CH_2Cl_2
Dichloromonofluoromethane
(Freon-21) .... $CHCl_2F$
Dichlorotetrafluoroethane
(Freon-114) .... $C_2Cl_2F_4$
Monochlorodifluoromethane
(Freon-22) .... $CHClF_2$
Trichloromonofluoromethane
(Freon-11) (Carrene No. 2) CCl_3F
Trichlorotrifluoroethane
(Freon-113) .... $C_2Cl_3F_3$

Should other refrigerants of similar properties be developed at some future time, they may be added to the above list.

"2. A pressure- or temperature-sensitive relief valve or device shall be located in the high-pressure side of the system and shall be vented to the outside of the passenger and baggage compartments and air-circulating system for the passenger compartment. In no case shall the blow-off pressure be greater than 800 psi or its saturated-vapor temperature equivalent.

"3. The high pressure side of the system (that part contained between the discharge valve of the compressor and the throttling orifice of the expansion valve) shall be designed for an ultimate pressure of not less than three times the blow-off pressure setting of the safety relief valve or device.

"4. A plainly legible and durable name plate or tag shall be mounted near the point where the refrigerant is charged into the system. This name plate or tag shall indicate the type of refrigerant to be used and the recommended operating charge. The same name plate, or additional plates mounted to one or more of the principal components of the system where it or they can be easily seen, shall contain the following information:

(a) Name or model, or both name and model, of the cooling system.

(b) Name and location of the manufacturer."

The recommendations were drawn

Continued on Page 103

These actions have been approved recently by the SAE Technical Board . . .

AMERICAN STANDARDS—The SAE, as one of the sponsors of ASA Sectional Committee B-5 on Standardization of Small Tools and Machine Tool Elements, has approved these proposed American Standards prepared by B-5:

- Designation and Working Ranges of Surface Grinding Machines of the Reciprocating Table Type
- Designation and Working Ranges of Plain Cylindrical Grinding Machines

The first proposed standard applies to all sizes of reciprocating table surface grinders with horizontal spindles. It defines machine size, gives serial number requirements, and specifies wheel sleeve diameters, width and length of working surfaces, and longitudinal, transverse, and vertical travel.

The second proposed standard covers all swings of plain cylindrical grinding machines up to and including 36 in. It, too, defines machine size and gives serial number requirements, then specifies wheel hole sizes, swing, length, nominal swing, and nominal length.

CIRCUIT BREAKERS—Provision has been made in a revision of this SAE Recommended Practice for the 12-v systems used on some 1953 passenger cars.

SEALED BEAM HEADLAMPS—Maximum candlepower values for the positions 3U, 2U, and 1U in the table accompanying Fig. 1 of the SAE Recommended Practice on Sealed Beam Headlamp Units for Motor Vehicles have been canceled.

The maximums were included originally because of a stipulation in the Uniform Code and many state laws that beam candlepowers in the upper beam 1 deg above the horizontal and higher should not exceed 8000 cp. The stipulation is no longer in the Uniform Code, and it is anticipated that state laws will be modified to conform.

NEW MANGANESE STEEL—SAE 1345 has been added to the list of SAE standard steels. Its composition is: 0.43-0.48% carbon, 1.60-1.90% manganese, 0.04% phosphorus, 0.04% sulfur, and 0.20-0.35% silicon.

STARTER AND GENERATOR CURVES—An additional curve for 12-v automobile systems has been added to Fig. 1, Voltage Curves for Starter Tests, of this SAE Recommended Practice. The curve is a straight line, passing through the points 100 amp, 10v and 400 amp, 6v.

CIGAR LIGHTER SWITCH BASES—This SAE Standard has been revised to include dimensions for 12-v bases. The dimensions have been worked out so that 6-v plugs can't be inserted in 12-v bases.

Out to Lunch

SAE Technical Board

It has become a yearly tradition for the SAE Technical Board to wind up its meeting at the Annual Meeting in Detroit with a buffet luncheon. Technical Board members have come to look forward to this help-yourself meal, featuring a variety of meat dishes, cheeses, and hot and cold delicacies. Shown below are some of the 1952 and 1953 Board members at luncheon after the meeting last

W. M. Walworth, Reo Motors, Inc. (left), and C. E. Mines, Allison Division, GMC

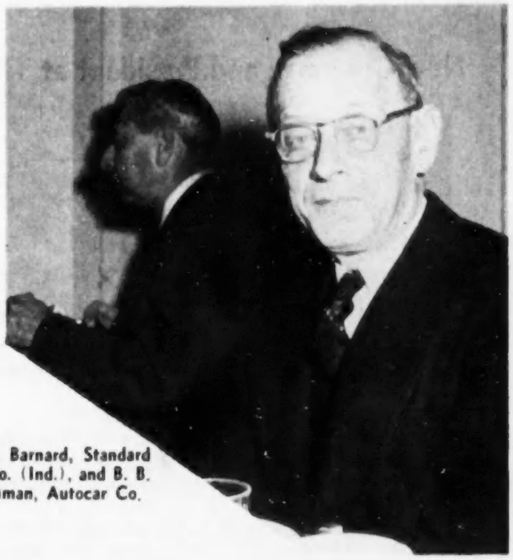
A. F. Meyer, Jr., Heil Co.

E. G. Haven, General Electric Co. (left), and R. P. Kroon, Westinghouse Electric Corp.

R. J. S. Pigott, Gulf Research & Development Co. (left); M. E. Nuttila, Cities Service Oil Co. (center); and 1952 Chairman of the Technical Board, G. A. Delaney, Pontiac Motor Division, GMC

January at the Sheraton-Cadillac Hotel.

The members of the '53 Board not shown here are: P. C. Ackerman, Chrysler Corp.; W. G. Lundquist, Wright Aeronautical Division, Curtiss-Wright Corp.; E. W. Tanquary, International Harvester Co.; H. E. Churchill, Studebaker Corp.; C. A. Chayne, General Motors Corp.; and R. P. Lewis, Spicer Mfg. Division, Dana Corp.



D. P. Barnard, Standard Oil Co. (Ind.), and B. B. Bachman, Autocar Co.

Technical Board Chairman E. S. MacPherson, vice-president of engineering, Ford Motor Co.

B. G. VanZee, Minneapolis-Moline Co. (left), and G. E. Burks, Caterpillar Tractor Co.

F. N. Piasecki, Piasecki Helicopter Corp. (left), and R. D. Kelly, United Air Lines

H. W. Browall, Inland Steel Co.

New Chairman and President at Thompson Products

Crawford

Wright

FREDERICK C. CRAWFORD, president of Thompson Products, Inc., Cleveland, became chairman of Thompson's board of directors on April 1. **JOHN D. WRIGHT**, formerly vice-president and general manager, succeeded him as president and will continue as general manager.

A graduate of Harvard College and Harvard Graduate School of Applied Sciences, Crawford joined the Steel Products Co., later Thompson Products, in 1916. He served as manager of Thompson's Detroit plant from 1922 to 1929, when he returned to Cleveland to become first vice-president and general manager. He was named president in 1933.

Wright joined Thompson in 1933 as assistant to President Crawford. He became a director in 1939 and a vice-president in 1943. He has been general manager of Thompson since 1949.

About

WILLIAM F. LITTLE has been named president of Electrical Testing Laboratories, Inc., New York City. He was previously vice-president and manager of lighting, photometric and related services. Little is past-president and a fellow of the Illuminating Engineering Society. He is a member of SAE's Lighting Committee, on which he has played an active part for many years.

W. S. COWELL has been appointed vice-president in charge of sales of the Atlas Asbestos Co. Ltd., Montreal, Que. He was previously general sales manager. Cowell is an SAE Councilor and is past-chairman of Montreal Section.

S. L. CRAWSHAW has been named president of Amgears, Inc., Chicago, a subsidiary of the Hupp Corp., and will also be executive head of Amgears' Chicago operations. He was previously assistant to the president of Western Gear Works, Lynwood, Calif. Crawshaw is currently president of the American Gear Manufacturers Association.

WILLIAM B. BERGEN has been named vice-president in charge of operations of the Glenn L. Martin Co., Baltimore, Md. Bergen has been vice-president and chief engineer since 1951, and before that had been chief engineer since 1949. He joined the company in 1937.

EUGENE M. LANG has resigned as vice-president of Heli-Coil Corp., Danbury, Conn., to become president of the newly-formed Resources and Facilities Corp., exclusive licensee under Heli-Coil patents throughout the world except for the western hemisphere. Lang, who will continue to serve Heli-Coil Corp. as a consultant, has done considerable work abroad in developing foreign markets and licensees for Heli-Coil.

FRANK N. PIASECKI, chairman of Piasecki Helicopter Corp., has announced the formation of Piasecki International Corp., a wholly-owned subsidiary. Piasecki will serve as chairman of the board and president of the new corporation. Among the other directors of Piasecki International are **DON R. BERLIN** and **HARRY S. PACK**, president and vice-president respectively of the parent corporation.

ROBERT P. ROGERS has joined Bendix Products Division, South Bend, Ind., as staff assistant to the manager of the missile division. Rogers was formerly assistant plant superintendent for A. O. Smith Corp. in Rochester, N. Y.

GEORGE L. BRINKWORTH has been transferred to Atlanta, Ga., for the Aluminum Co. of America. He was previously resident manager for Alcoa in Indianapolis, Ind.

Members

FRANK JARDINE is now consultant to the Cleveland Development Division of Aluminum Co. of America, following his retirement as the Division's manager. Jardine had been manager since 1923, and before that was at Alcoa's laboratory in Detroit. **H. HOWARD DUNN**, who has been assistant manager of the Cleveland Development Division for the past three and a half years, succeeds Jardine as manager.

WILLIAM B. BIRREN has resigned as plant manager of Grand Central Aircraft Co. in Tucson, Ariz. Birren plans to continue to live in Tucson, and to take a rest before undertaking any new business venture.

J. A. GILLIES has been named chief engineer for Canadian Pacific Air Lines, Vancouver, B. C. He was previously technical assistant to the manager of the aviation sales department of Imperial Oil, Ltd., Toronto, Ont.

J. L. COURSEY has been promoted to manager of the quality control department at the forge plant of Ford Motor Co's aircraft engine division, Chicago. He was previously technical assistant for the division.

DONALD G. WRIGHT has been named assistant to the president of the Standard Products Co., Cleveland, Ohio. Wright was formerly with Chrysler Division of Chrysler Corp., Detroit.

RICHARD E. REITER is now superintendent of the landing gear division of Willys-Overland Motors, Inc., Toledo, Ohio. Reiter was previously general manager of the Leading Engine Co., Farmington, Mich.

J. H. CARMICHAEL, president of Capital Airlines, Inc., Washington, D. C., has been reappointed to the industry consulting committee of NACA for 1953.

PAUL C. BAKER is now account executive for the Biddle Advertising Co., Bloomington, Ill. Baker was formerly with the Farm Journal, Chicago.

THOMAS A. NICHOLSON has joined Thompson Products, Inc., Cleveland, as Detroit district manager of the piston ring division. Nicholson was formerly with the manufacturers' engineering department of Perfect Circle Corp., Hagerstown, Ind.

ROBERT G. MORGAN has been named district manager in Moline, Ill., for Timken Roller Bearing Co.'s industrial division. He has been with Timken since 1937, most recently as district manager of the St. Thomas, Ont., office.

EDWIN H. WALKER has been named president and general manager of McKinnon Industries, Ltd., a subsidiary of General Motors Corp. in St. Catherines, Ont. Walker has been with McKinnon since 1933, and has been assistant to the general manager for the past two years.

EMERY J. SZABO has been named chief engineer of Leece-Neville Co., Cleveland, Ohio. He joined the company as a design engineer in 1942, and was promoted to development engineer in 1949.

OLIVER E. RODGERS has been appointed chief engineer of the jet engine division of Packard Motor Car Co., Detroit. He was formerly assistant manager of the gas turbine division of Westinghouse Electric Corp. in Philadelphia.

GMC's Detroit Diesel Engine Division Appoints Nine to New Posts

Dickson—chief design and development engineer

Hall—chief experimental engineer

Conover — assistant supervisor, engine design section

Baxley — operations sales manager

Wellington — assistant laboratory director

Reddy—development engineer

Ervin—project engineer

Whiteford — project engineer

Kenyon — assistant project engineer

Nine SAE members at Detroit Diesel Engine Division of GMC recently received new titles. **JOHN DICKSON**, who was previously chief design engineer, became chief design and development engineer. **J. A. HALL**, former chief project engineer, is now chief experimental engineer.

GEORGE W. CONOVER was named assistant supervisor of the engine design section. He was formerly analyst in the forward design section. **ROBERT V. BAXLEY** became operations sales manager, after having served as contractor's equipment sales manager. **R. D. WELLINGTON**, previously project engineer on the Model 51 engine, is now assistant director of the laboratory.

V. C. REDDY was named development engineer supervising all development work on the Division's engines. He was formerly project engineer on the Model 71 engine. **CHARLES E. ERVIN**, who has been assistant application engineer, is now project engineer on Model 51 engine development. **ROBERT W. WHITEFORD** was promoted from assistant project engineer to project engineer on the Series 71 basic engine, and **WILLIAM S. KENYON, JR.**, formerly senior layout man, became assistant project engineer on the Series 71 engine.

HANS BOHUSLAV has been appointed general manager of the new Miehle-Dexter Supercharger Division of Dexter Folder Co., Racine, Wis. The Division was previously owned and operated by Pesco Division of Borg-Warner Corp. Bohuslav was formerly chief engineer, engine construction, for R. G. LeTourneau, Inc., Longview, Texas.

A. L. SPRINGER is now director of fleet maintenance for Spector Motor Service, Inc., Chicago, Ill. He was previously manager of transportation and properties for Pacific Intermountain Express Co., Denver, Colo.

DR. GUSTAV EGLOFF, director of research of Universal Oil Products Co., Des Plaines, Ill., has been elected an honorary member of the Association Francaise des Techniciens du Petrole, Paris, France.

FREDERICK L. GREEN is now a tractor automotive engineer for Ford Motor Co., Dearborn, Mich. Green was formerly winch and crane engineer for Gar Wood Industries, Inc., Wayne, Mich. He had been with Gar Wood for 15 years.

ROBERT L. ADAMS has joined the Cooper-Bessemer Corp., Mount Vernon, Ohio as sales engineer. He was previously research engineer at Harvard University's Division of Applied Science.

GEORGE E. BILLMAN is now liaison engineer with the aircraft division of White Motor Co., Cleveland, Ohio. Billman was formerly specifications engineer for Lycoming-Spencer Division of Avco Mfg. Corp., Williamsport, Pa.

ROBERT M. WHELAN has returned to American Bosch Corp. after a year and a half's service as an Army aviation engineer. He is now training as a field service representative at the company's headquarters in Springfield, Mass. Before entering the Army, Whelan was sales representative for American Bosch in New York City.

JAMES E. WASEM, JR., is now with the development and research department of Continental Oil Co., Ponca City, Okla., as research engineer. He was previously automotive engineer for the research and development division of Socony-Vacuum, Paulsboro, N. J.

JOSE M. CRUZ TOUS has been appointed sales manager for Aspuru y Cia. S. A., Cuban distributor for Tide Water Associated Oil Co. in Havana. Cruz Tous was formerly manager of Abelardo Tous, Havana.

HENRY J. GRANCE has been appointed chief product engineer, gasoline section, of the product development and product engineering department, Gulf Oil Corp., Pittsburgh, Pa. He joined Gulf in 1946 as an engineer in the aviation section of Gulf Research and Development Co.

JOSEPH A. TANTET is now technical representative of the Aronite Chemical Co., a subsidiary of Standard Oil Co. of California, in Dallas, Texas. Tantet recently completed two years of service as lieutenant commander at the Navy's Bureau of Ships, Washington, D. C., where he was technical assistant in the fuels and lubricants division. Prior to that, he was research engineer for the California Research Corp.

KENNETH A. PICKERING, who was formerly designer for GMC's Fisher Body Division, is now with the General Motors Styling Section, Detroit.

ROBERT P. ZUNDEL is now product test engineer with the aircraft engine division of Ford Motor Co., Chicago. Zundel was formerly product tester for the motor truck division of International Harvester Co., Fort Wayne, Ind.

P. J. KENT will return May 10 from a month's tour of the Far East sponsored by the Detroit Board of Commerce. Itinerary for the trade tour, the fourth sponsored by the Board of Commerce, includes conferences with businessmen and government officials in Tokyo; Osaka; Taipei, Formosa; Hongkong; Bangkok; Singapore; Manila; and Honolulu. In previous years, Kent, executive engineer of Chrysler Corp., has participated in tours of South America and Europe.

THOMAS E. COON is now project engineer for the aircraft engine division of Packard Motor Car Co., Detroit. Coon was previously project engineer in the ordnance department at Detroit Arsenal.

QUENTIN W. CRANE is now service manager of Duckworth Motor Co., Brevard, N. C. He was formerly sales manager of the Mitchell Motor Co. in Brevard.

ROBERT F. GASVODA has joined the engineering research department of Ford Motor Co., Dearborn, Mich., as lubrication engineer. He is engaged in organizing a new activity concerned with the evaluation and application of petroleum products. Gasvoda was previously research automotive engineer for the Standard Oil Co. (Indiana) at Whiting, Ind.

EDWARD H. FARMER has been elected vice-president of manufacturing of Pacific Airmotive Corp., Burbank, Calif. Farmer was previously works manager for Lockheed Aicraft Corp. in Burbank, and had been with Lockheed since 1941.

NORMAN S. SMITH is now engineering superintendent at the Miami Overhaul Base of Pan American World Airways, Inc., Miami, Fla. He was previously with Pan American in New York City. Smith is a member of SAE's Aircraft Electrical Equipment and Aircraft Instruments Committees.

H. L. EBERTS of Canadair, Ltd., Montreal, Que., is currently serving as managing director of Fleet Manufacturing, Ltd., in Fort Erie, Ont., to aid Fleet Manufacturing in production for Canadair. Eberts is chairman of Montreal Section.

Chrysler Vice-Presidents meet the Press . . .

Exclusive interview on Chrysler Corp.'s K-310 experimental car was granted to 11-year old editor Bill Reeves by Chrysler Vice-Presidents **A. vanderZEE** (center) and **JAMES C. ZEDER** (right) when they visited New Orleans recently. Young Reeves edits "Tiger Times," which boasts a circulation of 13 and comes out every Wednesday.

Named Sales Manager of Two Detroit Harvester Divisions

Wade

Gallatin

FRANK C. WADE has been named sales manager of Motor State Products, Ypsilanti, Mich., and the Dura Co., Toledo, two divisions of Detroit Harvester Co. Wade, who has been with Detroit Harvester for 14 years, succeeds **JOHN T. GALLATIN,** who will continue as vice-president, sales consultant and director of advertising.

J. H. McNULTY has been promoted to sales manager of the Four Wheel Drive Auto Co., Ltd., Kitchener, Ont. McNulty joined the Canadian company in 1946 as sales representative for western Canada.

JOHN R. McVEIGH is now chief engineer of the Alloy Engineering and Casting Co., Champaign, Ill. He was formerly special development engineer of Kennametal, Inc., Latrobe, Pa.

A. A. SHANTZ has been named assistant general sales manager for trucks of GMC's Truck and Coach Division, Pontiac, Mich. Shantz has been general parts and service manager of the Division since 1944.

MARTIN J. CASERIO has been named resident assistant chief engineer of GMC's AC Spark Plug Division, Flint, Mich. He was previously engineer on military products for the division.

DONALD S. BOWMAN is now branch manager of Columbia Truck Leasing, Inc., Little Rock, Ark., a subsidiary of Columbia Terminals Co. He was formerly with Columbia Transportation Service, Inc., also a subsidiary of Columbia Terminals, as sales manager.

LOUIS STEVENS is now a salesman for the A. B. Scarlett Co., Eugene, Ore. He was previously sales manager for Wentworth and Irwin, Inc., Portland, Ore.

Four SAE members will be among the lecturers in an intensive two-week course in gas turbines at the University of Michigan, June 29 to July 10. They are **N. A. HALL,** professor of mechanical engineering and head of the heat engineering division at the University of Minnesota, and, from the University of Michigan, **EDWARD T. VINCENT,** chairman of the department of mechanical engineering, **FRANK L. SCHWARTZ,** professor of mechanical engineering, and **JOHN W. LUECHT,** assistant professor of aeronautical engineering. Requests for information should be sent to Professor Schwartz at the University of Michigan, Ann Arbor.

HAROLD H. HALL, who was previously general manager of Cummins Diesel Export Corp., has joined GMC's Truck and Coach Division, Pontiac, Mich., as field development engineer. Before being transferred to Cummins Diesel Export, Hall was general service manager of Cummins Engine Co.

HORACE HOLMES is now automobile sales manager for Clauss Motors in Medford, Ore. Holmes was previously assistant service manager for Nash Motors Division of Nash-Kelvinator Corp. in San Francisco.

JOHN B. BUTLER has been named aircraft contracts engineer for Bristol Engineering Corp., Bristol, Pa. Butler was formerly project engineer for the company's aeronautical division.

EDWARD G. JACKSON has been promoted to zone manager for Federal-Mogul Service. He will be in charge of 11 western states, with headquarters in North Sacramento, Calif. Jackson was previously district manager in Dallas, Texas.

JAMES L. CARLISLE has joined Chrysler Corp.'s central engineering, Highland Park, Mich., as a body draftsman. Carlisle was previously body draftsman for Willys-Overland Motors, Inc., Toledo, Ohio.

JOHN L. KORLESKI has been named general manager of the Southwestern Mobile Home Co., Grand Saline, Texas. He was formerly general manager of All States Trailer Co. in Jacksonville, Ark.

JAMES A. HUNTER has joined GMC's Truck and Coach Division, Pontiac, Mich., as senior layout draftsman. He was previously draftsman-designer for Waukesha Motor Co., Waukesha, Wis.

RAYMOND GROSE has been named process and quality control manager of Lock Thread Corp., Detroit. He was formerly zone supervisor of subcontract inspection for the aircraft gas turbine division of General Electric Co., in Detroit.

WILBUR SHAW, president of the Indianapolis Motor Speedway Corp. and three-time winner of the 500-mile race, will be referee and a member of the Board of Stewards for the 1953 Mobilgas Economy Run from Los Angeles to Sun Valley, Idaho. **EARL COOPER** will also serve on the Board of Stewards.

HOWARD W. COLE, JR. described the new Gavco flow meter to trade and press representatives at the Wings Club in New York, March 10. The new Gavco unit measures the volume of the flow and its density, then combines the two measures to give an actual mass flow reading, Cole said. Cole predicted the meters would be especially useful on fuel systems of turbine engines for aircraft. That's because thrust depends on fuel mass flow, and fuel mass per unit volume—or density—varies with temperature and pressure . . . and even from topping to topping.

Cole also foresaw other applications such as measurement of slurries in the ceramics field and control of fluid flows in the petroleum and chemical processing industries.

Cole is now on the development staff of the Gavco Corp., which is a subsidiary of the General Aviation Corp.

EDWARD HOWE, who was previously with the Buda Co., is now a designer with General Electric Co., Cincinnati, Ohio.

MICHAEL K. PETRI, previously zone manager of the International Harvester Co., Portland, Ore., has been transferred to the Denver district and is now district service supervisor.

MORRIS CRANDALL, formerly of the Paraland Oil Co., is now assistant to the president of J. D. Streett & Co., Inc., St. Louis, Mo.

SIR HARRY R. RICARDO has completely revised his well-known work on engines. The new, fourth edition of the "High-Speed Internal-Combustion Engine" concentrates on the research, design, and development work that has been done in the Ricardo laboratory during the last 35 years, and the experiences and lessons the author has derived from it.

He has paid particular attention to those aspects of the subject that do not appear to have been given much prominence in current literature. For instance, he covers the subject of mechanical efficiency in considerable detail, since he feels it has been sadly neglected by engineers. Publisher is Black & Son, London.

JOHN L. MILLEN is now estimating engineer for the Foundation Co. of Canada in Gaspe, P. Q. Millen was previously sales engineer for John Millen and Son, Ltd., in the city of Quebec.

MEREDITH C. HOWELL is now sales manager for the Carl Berry Oil Co., Kansas City, Mo. He was previously with the Union Oil Co. of California.

LAWRENCE C. OLSEN has been named Chicago district field engineer for the American Locomotive Co., Schenectady, N. Y. Olsen was formerly equipment engineer for the company in Schenectady.

RICHARD L. CATLIN is now a design engineer for the Engineering and Research Corp., Riverdale, Md. He was previously structural design engineer for the Kaman Aircraft Corp., Windsor Locks, Conn.

DONALD E. FERRO is now a junior project engineer with the Clark Equipment Co., Buchanan, Mich. Ferro was formerly a junior engineer with Bendix Products Division, Bendix Aviation Corp.

BRUCE CRANE, who was previously a field engineer with the Ethyl Corp. in Tulsa, Okla., is now a senior sales and service engineer at Ethyl's New York office.

EMMETT C. MANNING is now a project engineer with GMC's Harrison Radiator Division, Lockport, New York. Manning was formerly an experimental engineer at Wisconsin Motor Corp., West Allis, Wis.

OTTO L. KRAFT has joined the Knoxall Corp., Indianapolis, Ind., as manager of the lubrication department. He was formerly associated with the Ohio Oil Co.

ELLIOT L. TAYLOR has joined the instrument division of Thomas A. Edison, Inc., West Orange, N. J., as a project engineer. Taylor was previously associate engineer with Reaction Motors, Inc.

WILLIAM M. DUNN is now with the Ford Motor Co. as process engineer at the Dearborn general manufacturing division. He was previously with the Kett Corp., Cincinnati, Ohio.

CHARLES A. L. RUHL has joined the Massey-Harris Co., Racine, Wis., as a project engineer. He was formerly with McDonnell Aircraft Corp., St. Louis, Mo.

GORDON C. PAGE, formerly administrative service engineer with Continental Aviation and Engineering Corp., is now sales engineer with the Chrysler Corp., Trenton, Mich.

C. KENNETH KUMMERLOWE has joined the Four Wheel Drive Auto Co., Clintonville, Wis., as manager of the experimental engineering department. Kummerlowe was formerly with Fairchild Engine in Farmingdale, New York.

PAUL H. SWARD, fuel and lubricant engineer with Standard Oil Co. of Calif., has been transferred from Boise, Idaho, to Pasco, Wash.

NORMAN F. THOMPSON, JR. has joined the Baldwin-Lima-Hamilton Corp., Philadelphia, Pa., as assistant project engineer. Thompson was previously an assistant engineering officer in the U. S. Coast Guard.

Obituary

PATRICK J. BRADY

Patrick J. Brady, president and general manager of West Coast Electronics Co., Los Angeles, died Feb. 24 after a brief illness. He was 62.

Born in Washington, Ind., Brady moved to the west coast in 1921 after having served with the U. S. Naval Air Service. He was general manager and secretary of the Interstate Aircraft and Engineering Corp., El Segundo, Calif., for five years before joining Pacific Aviation, Inc., Los Angeles, as general manager and chairman of the board.

Brady was vice-president of the Los Angeles Rotary Club, and was also a member of the American Legion, the Veterans of Foreign Wars, the American Ordnance Association, and SAE.

He is survived by his wife.

STUDENTS ENTER INDUSTRY

GEORGE W. SHEARDOWN (Wayne University '52) is a production engineer on jet engines for Chrysler Corp., Detroit.

GENE F. PIERSON (Rennselaer Polytechnic Institute '52) is in training with Westinghouse Electric Corp., Pittsburgh, Pa.

EDWARD F. KRZYSTAN (University of Detroit) is with Inland States Mfg. Co., Detroit, as a toolmaker.

ROGER J. ROBERTS (Ohio State University '51) has joined General Electric Co., Schenectady, N. Y., as a test engineer.

GALDINO SALVADOR (Wayne University '52) is a production engineer at Chrysler Corp.'s jet engine plant, Detroit.

WALTER A. KOSZTOWNY (University of Detroit '52) is with Kaiser-Frazer Corp., Willow Run, Mich., as liaison engineer.

RICHARD P. BOBCO (Northwestern University '52) is now a junior engineer in the technical department of Gates Rubber Co., Denver, Colo.

ROBERT J. BAYER (University of Detroit '52) is a production engineer with the aircraft engine division of Packard Motor Car Co., Detroit.

DAVID C. BALL (University of Cincinnati '52) is at the Frankford Arsenal Annex, Philadelphia, Pa., as product engineer.

STEPHEN H. ACHTENHAGEN (University of Colorado '52) is administrative assistant engineer for Lockheed Aircraft Corp., Burbank, Calif.

PAUL M. AAGAARD (California Institute of Technology '52) is a research engineer for California Research Corp., La Habra, Calif.

DOUGLAS F. CORSETTE (Purdue University '52) is on the technical staff of the research and development laboratories of Hughes Aircraft Co., Culver City, Calif.

DANIEL DINSMORE, JR. (Parks College '51) is a test technician for Bridgeport-Lycoming Division of Avco Mfg. Corp., Stratford, Conn.

ANDREW J. CLARK (Illinois Institute of Technology '52) is with Johnson Motors, Waukegan, Ill., as an experimental engineer.

LUIS CHONG-LEON (University of Illinois '52) has joined the International Harvester Co., Chicago, Ill.

LUCIEN HUBERT (Ecole Polytechnique '52) is now teaching at the Ecole de Marine et Ecole Technique in Rimouski, P. Q.

GEORGE WISNIEWSKI (University of Detroit '52) has joined Ford Motor Co., Dearborn, as die model and gage process draftsman.

ROBERT KWOH-TAO-WOO (University of Michigan '52) is now work standards analyst at the River Rouge plant of Ford Motor Co.

VICTOR F. BURT (California State Polytechnic College '52) is a marine engineer at the San Francisco Naval Shipyard.

ROBERT C. BROOKS (California State Polytechnic College '52) is now with the Sierra Tractor and Equipment Co., Chico, Calif.

DONALD W. BAUDER (University of Colorado '52) is a junior engineer with the powerplant group of Consolidated Vultee Aircraft Corp., San Diego, Calif.

T. C. MADDEN (Southern Methodist University '52) is office engineer on compressor sales for J. B. Beaird Co., Inc., Shreveport, La.

JOHN S. DERDERIAN (University of Iowa '52) has joined the engineering department of Deere and Co., Moline, Ill.

HOWARD A. DOBSON (Michigan College of Mining and Technology '52) is a sales trainee for the Ladish Co., Cudahy, Wis.

DALE SCHENK (Tri-State College '52) is an industrial engineer, sub-assembly group, for Chance-Vought Aircraft Co., Dallas, Texas.

FRED P. CAIRO (University of Illinois '52) is a sales engineer trainee for the Buda Co., Harvey, Ill.

ANTHONY J. SUCHOSKI (Lawrence Institute of Technology '51) is test and development engineer for Chrysler Corp., Detroit.

JAMES C. HUSSONG (University of Maryland '51; Yale University '52) is a design engineer for Thompson Trailer Corp., Pikesville, Md.

ROBERTO A. CANTU (Purdue University '52) is now with the service department of Maquinaria Diesel, S.A., in Monterrey, Mexico.

LAWRENCE J. FLANIGAN (Ohio State University '52) is a second lieutenant in the Corps of Engineers at Fort Belvoir, Va.

GEORGE V. DERISLEY (Lawrence Institute of Technology '50) has been released from the U. S. Navy and is now with the structure and development group at the General Motors Technical Center, Detroit.

EDWARD S. CLARK (West Coast University '52) is a field engineer for Bendix International Corp., New York City.

KENNETH C. ENGEL (Aeronautical University '52) is a rocket test engineer for Bell Aircraft Corp., Niagara Falls, N. Y.

ARTHUR ECK (Northrop Aeronautical Institute '52) has joined Northrop as an aeronautical engineer.

WILLIAM E. DUNN, JR. (University of Massachusetts '52) is vibration test engineer for Hamilton Standard Division of United Aircraft Corp., Windsor Locks, Conn.

ISAAC GARROTT, JR. (Parks College '52) is with Cessna Aircraft Co., Wichita, Kans., as aeronautical engineer.

LEO J. PEOT (Washington State College '52) is now a second lieutenant in the U. S. Air Force stationed at Keesler Air Force Base, Miss.

RICHARD LEROY MOYER (Pennsylvania State College '52) is now with E. I. duPont's Savannah River Plant, Augusta, Ga., as an engineer in the maintenance department.

DAVID LOY MAU (Aeronautical University '52) has joined Northrop Aircraft, Inc., Hawthorne, Calif., as a stress analyst.

ROBERT R. MARKGRAF (Case Institue of Technology '52) is an engineering assistant with the Tapco Plant of Thompson Products, Inc., Euclid, Ohio.

S. OTTO DUEMLER (Cal-Aero Technical Institute '52) is a junior engineer at Consolidated Vultee Aircraft Corp., San Diego, Calif.

MELVIN L. CHRISTIANER (Parks College '52) is now with the Beech Aircraft Co., Wichita, Kans., as a structural engineer.

FLORIAN J. JOLDA (Parks College '50) has joined Pratt & Whitney Aircraft, East Hartford, Conn., as an engine test inspector.

G. SEAVEY AUSTEN (Carnegie Institute of Technology '52) is in the U. S. Marine Corps. He is a student in radar repair at MCR Depot, San Diego, Calif.

SAE Section Meetings

MAY

Buffalo—May 19

Cherry Hill Country Club, Ridgeway, Ont., Canada. Dinner 7:30 p.m., meeting 8:30 p.m. Talk on Industrial Applications of Atomic Power. Speaker to be announced. Annual golf meeting.

Canadian—May 22

Genosha Hotel, Oshawa, Ont. Dinner 6:30 p.m., meeting 8:00 p.m. Niagara Power Development—J. R. Montague, chief of engineering development, Ontario Hydro Commission.

Central Illinois—May 25

Jefferson Hotel, Peoria. Dinner 6:30 p.m., meeting 7:45 p.m. Engineering Frontiers—1953 SAE President Robert Cass. President's Night.

Cleveland—May 11

Lake Shore Country Club. Dinner 6:30 p.m., meeting 7:30 p.m. Sports Cars—James K. Gaylord, Gaylord-Shelton Co. Display and demonstration of sports cars at 4:00 p.m. Also movie on the LeMans race.

Colorado—May 21

Petroleum Club. Dinner 6:30 p.m., meeting 8:00 p.m. Automotive Safety-Engineering and Design—Carl Seashore, president, Seashore & Associates.

Indiana—May 21

Marott Hotel. Dinner 7:00 p.m., meeting 8:00 p.m. Cummins Diesel Race Car—D. J. Cummins, vice-president, engineering, Cummins Engine Co.

Metropolitan—May 15

Knollwood Country Club, Elmsford, N. Y. Dinner 8:30 p.m. Dinner and Dance. Golf, Cards, Prizes, Sponsored Cocktail Hour. Price $9.00 per person.

Mid-Continent—May 22

Ponca City, Country Club. Dinner 7:00 p.m. Engineering Frontiers—1953 SAE President Robert Cass. Annual Ladies Night Meeting. Local dealers will have 1953 model cars and foreign cars to show and drive. Social hour 6:00 p.m.

Mid-Michigan—May 19

Owosso Country Club. Dinner 7:00 p.m., meeting 8:00 p.m. Power Brakes for Passenger Cars—D. T. Ayers, development engineer, Kelsey-Hayes Wheel Co. and E. E. Hupp, development engineer, Bendix-Westinghouse. Golf meeting.

Mohawk-Hudson—May 8

Locomotive Club, Schenectady. Meeting 8:00 p.m. Ladies Night. Films, entertainment, and dancing. Buffet supper will be served.

New England—June 3

Woodland Country Club, Newton, Mass. Annual outing and outing dinner. Golf, soft ball, horseshoes. Displays of new and ancient cars.

Northern California—May 14

Engineering Frontiers—1953 SAE President Robert Cass.

Northwest—May 8

Town and Country Club, Seattle. Dinner 6:30 p.m. Engineering Frontiers—1953 SAE President Robert Cass. Dinner-meeting honoring Past Chairmen of SAE Northwest Section.

Oregon—May 13

Engineering Frontiers—1953 SAE President Robert Cass.

Philadelphia—May 22

Overbrook Golf Club. Dinner 7:00 p.m. Ladies Night, entertainment, dancing and golfing.

Pittsburgh—May 21

Wanango Country Club, Reno, Pa. Spring Outing.

St. Louis—May 21

Forest Park Hotel. Student Activity Meeting. Joint Meeting with I.A.S. The Nash-Healey Sports Car—E. L. Monson, chief development engineer, Nash Motors of Kenosha, Wisconsin.

Southern California—May 14

Rodger Young Auditorium. Dinner 6:30 p.m., meeting 8:00 p.m. Mac Short Memorial Award will be presented to outstanding student engineers in Section. The paper to be presented will be of interest to aircraft engineers as well as those interested in jet power.

Southern New England—May 15

Wethersfield Country Club. Dinner 7:00 p.m. Annual social gathering. Ladies Night. Dancing and movies.

Spokane-Intermountain—May 11

Spokane Hotel, Silver Room. Dinner 6:30 p.m., meeting 8:30 p.m. Engineering Frontiers—1953 SAE President Robert Cass.

Twin City—May 12

Curtis Hotel. Dinner 6:30 p.m., meeting 8:00 p.m. Development of the Guide Autronic Eye Automatic Headlight Control—D. P. Driftmeir, Guide Lamp Division, GMC.

Washington—May 19

Burlington Hotel. Dinner 6:15 p.m., meeting 8:15 p.m. Automobile Old Timers Experiences. Panel discussion, plus exhibition of old time automobiles and equipment. Ladies Night.

Western Michigan—May 16

Prospect Point Hotel, Spring Lake. Ladies Night.

Montreal—May 21

Mount Royal Hotel. Dinner 7:00 p.m., meeting 7:45 p.m. The Engineering Era—A. T. Colwell, vice-president engineering, Thompson Products.

This is not a complete list of all Section Meetings. It includes only those meetings for which we have received sufficient advance notice to permit listing.

New Car Air Cooling

Continued from Page 93

up by the SAE Motor-Vehicle Air Conditioning Committee. SAE formed the committee at the suggestion of the Automobile Manufacturers Association to provide recommended practices more useful and appropriate to automobiles than the specifications developed for buildings in many municipal codes.

After examining ASA B9.1-1950 (the American Standards Association document on which many codes for air conditioning systems in buildings are based), the SAE committee members agreed that B9 is inappropriate for passenger cars. So they strove to prepare the SAE Recommended Practice in a form that will be useful to people drafting motor vehicle regulations on the subject.

SAE Section Meetings

Lists Advantages Of Auxiliary Transmission

• Colorado Group

Robert F. Brown, Field Editor

March 19—In an illustrated talk, **J. R. Murphy**, regional sales manager of H. S. Watson Co., explained the importance of the auxiliary transmission.

Properly coordinated with the main transmission and axle differential gear ratios, Murphy said, the auxiliary transmission provides that extra flexibility in control of torque transmission which more effectively adapts the vehicle to the particular use. The gains obtained are: greater payloads at higher sustained speeds resulting from more constant power available, reduced operating costs by maintaining a higher proportion of engine operating time in an economical range, and reduced maintenance costs by holding engine speed more constant, thereby avoiding either low-speed lugging or excessive high speed.

Tells of Progress Of New Air Powerplants

• Washington Section

Allen P. Blade, Field Editor

March 17—Speaking before a packed house, **William Littlewood**, vice-president of engineering, American Airlines, Inc., reviewed the latest developments and trends in the design and operation of commercial air transports, including the problems faced by this country in the development and operation of the new jet transports which the British are already operating in commercial airline service.

Continuous progress and refinement of commercial transport airplanes and their engines, propellers, instruments and accessories, over the past 25 years, have brought us a number of modern airplanes of surprisingly uniform characteristics and with good performance and economy. The ever-increasing operation of these aircraft also shows continually improved safety and dependability of service, as well as increasing comfort to the passengers.

These developments have been largely in the nature of refinements of aerodynamic cleanliness, improvements in powerplant reliability and efficiency, consistent development of better and more versatile propellers, and substantial strides in structural strength and weight efficiency. The entire progress, however, has been without radical changes in principle or method, and has consisted of the trial and elimination of the less desirable design details, arrangements and equipments.

But now we are facing a revolution in the propulsion field. The current active adoption in British military and civil practice as well as American military use of turbojet models—and, to a lesser extent, turboprops—foretells the early adoption by American transport aircraft of much higher performance characteristics based on these new types of propulsion units.

The development and use of such equipment will involve many problems, some of which are already apparent. These include airport and aircraft ground handling problems, operational factors in the areas of traffic handling and close-in operation. Also involved are new techniques of flight planning and control, and innumerable meteorological enroute problems—some of which are not yet entirely clear. There will also be a large family of problems associated with the equipment itself which involves the airplane with its high speed and high altitude requirements and the new power plants, whether they be straight jet or turboprop type.

Pictures were used to show past and present experimental and standardized aircraft models. Slides illustrated performance characteristics and trends.

Many of the problems were discussed with members of the audience during the talk, and numerous suggestions were made for the handling of problems already recognized. Much research and development was urged in connection with requirements which will become clearer when actual operation of the aircraft becomes more extensive.

The talk included numerous references to improved safety features that will be urgently needed in the future. These arise partly from consideration of the increased performance of the future aircraft, and partly from recognition of the deficiencies apparent in currently operating transports of conventional type.

Littlewood emphasized that, despite many problems, the future holds the greatest promise and opportunity for engineers in air transportation and envisions future operations with greater safety, dependability, higher performance, and economy equal to or better than that available today.

Littlewood has been vice-president of engineering of American Airlines since 1937. He has been recognized internationally for his work in the development of the Douglas DC-3, DC-4, DC-6 and DC-6B and the Convair 240 commercial transports. He is a past vice-president of the SAE and has been active in many of its technical activities.

Torque Converter Praised for Heavy Duty

• Cincinnati Section

Edward B. Lohaus, Field Editor

March 23—**R. M. Schaefer** of GMC's Allison Division presented his paper on "The Hydraulic Torque Converter—its Effects on the Power Train."

Schaefer presented data gathered from operators of trucks used for earthmoving and hauling coal and ore to show that use of the torque converter in heavy duty equipment can add 47% to engine life, 400% to transmission life, and 93% to differential life.

Shock loads were 4.28 times greater when mechanical clutches were used, increasing wear on transmission and rear axle parts—which are costly to repair.

Experimental work is now proceeding with over-the-road heavy duty trucks, Schaefer said. Since repair of transmission and rear axle parts has been one of the major maintenance costs, the development of the torque converter would be a boon to owners.

The discussion period was enlivened by some of the local dump truck operators who were specially invited to the meeting. Fuel consumption was paramount among the problems brought up by operators. Schaefer

said that the difference in fuel consumption with mechanical and hydraulic transmissions is decreasing, and he feels confident that eventually the difference will be eliminated.

In conclusion Schaefer predicted that every year will bring greater use of the hydraulic transmission, and that eventually it will be available for vehicles of all types, sizes and designs.

City Driving Hardest on Engines

• Northern California Section
J. A. Miller, Field Editor

Feb. 25—"Frictional and Corrosive Wear" was the subject of the paper presented by **John A. Edgar,** chief research engineer of the Shell Oil Co.'s Martinez Laboratories.

Edgar presented data to show that wear in automotive engines is the result of abrasives, abrasion due to rubbing of engine parts, and corrosion, the corrosive wear being the major contributing factor in passenger car service. Contrary to popular notion, stop-start city traffic operation is the most severe service for such engines. It was pointed out that advances during the past few years in air filter design, improved engine metallurgy, and the development of additive oils have reduced this problem to the point where 75,000 to 100,000 miles of operation are possible, compared to the 35,000 to 50,000 miles of service previously considered normal. In spite of these great advances, Edgar emphasized, much work still remains to be done by the automotive and petroleum industry before the wear problem can be considered completely solved.

By prearrangement, Edgar's presentation was used to initiate audience participation in the discussion and an informal symposium on engine wear, its causes and cures was conducted by the technical chairman for the meeting, F. W. Kavanagh of the California Research Corp.

Edgar, an expert in the field of crankcase lubricants, received his B.S. from the University of California in 1929, after which he joined the staff at Wright Field. He joined Shell Oil Martinez Laboratory in 1933 and, except for a five year period in Naval Aviation during the war, has been engaged in petroleum research since that time. He now heads his department at the laboratory. In addition to his research, Edgar is an "old" and active SAE member, joining the Society as a Student Member in 1927. He is now vice-chairman of the Northern California Section.

Mexican Road Race Toughest, Speaker Declares

• Texas Section
Dale Kelly

March 9—"The Mexican Road Race is the toughest race in existence today, more severe than the Italian Mille Miglia or the Le Mans 24-hour race," declared **William Litchult,** addressing the student meeting of Texas Section's San Antonio Division. Stock cars are able to survive only by virtue of extensive modifications to springs, shock absorbers, and other chassis parts.

Many cars used extra strong "export" front wheel hubs, and one car had blowers installed in the trunk to cool the rear brakes. The rules require the engines to be stock, but considerable controversy arose after the 1952 race as to whether some of the minor modifications made should have been permitted to "stock" engines.

Largely because of the length of the race (2,000 miles) and the roughness of the roads, one contestant with four cars entered brought along 27 tons of spare parts. Tire life was generally not over one day; one fleet of four cars had over 300 spare tires available.

In describing his work on the Oldsmobile 88 driven by Dr. Harry Fleming of San Antonio in the 1951 race, the speaker said that he did not increase the engine compression ratio because he felt that the quality of fuel supplied by the race officials would not warrant this step. Since in a race of this length dependability becomes more important than extreme power, bore and stroke were left unchanged. Dual carburetion was used, and a number of other minor modifications were made to the induction and exhaust systems, each being checked by "before and after" tests on a chassis dynamometer. A larger generator pulley was used to reduce generator speed.

The maximum engine speed consistent with durability was estimated, red marks were painted on the speedometer dial at the corresponding points, and the driver was told to keep below these speeds except when overtaking. After the race it developed that the speed had generally been above the recommended maximum. When taken to task, Dr. Fleming said, "We were always passing someone." Since he advanced from 27th place to 4th place before going out at 200 miles due to a crash following a blow-out, this was probably not far from the truth.

Renewed Interest in Racing

In reviewing the history of road racing in this country, Litchult pointed out that at the beginning of the century the United States could offer good competition to the best road cars Europe produced. Later, interest in racing waned in this country, and in 1939 and 1940 our Indianapolis 500 was won by an Italian Maserati. Since World War II there has been a revival of interest in road racing. Briggs Cunningham, in particular, has met with considerable success in the major road races here, and his fourth place win last year at Le Mans placed him in the upper brackets of international competition. His sportsmanship won him considerable praise throughout Europe.

Development by the United States of a strong road racing team could, the speaker felt, be of inestimable value in promoting American prestige abroad.

The audience of approximately one hundred included about twenty engineering students, principally from the University of Texas at Austin, and delegations from two local auto enthusiast clubs.

Student Chairman Dale Kelly addresses the March 9 meeting of Texas Section's San Antonio Division, at which the pleasures and headaches of road racing were discussed. In the front row are Division Chairman J. J. Brett (wearing bow tie) and Secretary Calvin Meyers (in white suit)

Earthmoving Machines . . .

Great performers today, but builders and users at Peoria Conference see need to improve them for tomorrow.

Reported by

R. B. Applegate, Caterpillar Tractor Co., Field Editor, SAE Central Illinois Section

WE'VE got a glorious record. Let's make sure we keep it that way. Time and again these thoughts were expressed by the more than 800 members and guests at the Fourth Annual Earthmoving Industry Conference sponsored by the SAE Central Illinois Section in Peoria, April 8 and 9.

Keynoter R. S. Stevenson, of Allis-Chalmers, pinpointed the general feeling. The tremendous strides in the advancement of transportation and communications in the United States would have been impossible without mighty efficient earthmovers, he pointed out. In fact, this ability to move earth economically is one of the chief reasons why the U.S. has better roads and communication facilities than any other country in the world. But be that as it may, the industry is faced with a challenge to meet future demands on equipment, Stevenson added.

Boost Vehicle Mobility

For example, electric drives for earthmoving and construction machinery are highly developed items in the transportation and mining industries. And while they serve a variety of needs with considerable success and efficiency, mobility still is limited, noted Le Tourneau's D. K. Heiple. What's needed are electric-driven units that permit all-wheel steer and complete independence from outside power sources. The Tournatow is a step in the right direction, but even it has to be perfected, Heiple admitted.

He said the Tournatow is especially interesting if considered as the application of a basic propulsion principle rather than as a specific purpose tool.

Description of this vehicle gave a brief look at a development program that projects into the future. A diesel engine with two direct-connected generators forms the basic powerplant. One generator, a d-c unit, provides the power to operate d-c motors which drive the wheels. The other generator, an a-c job, supplies power for steering, auxiliary winching, battery charging, and auxiliary lighting.

Each wheel and its d-c motor swing together during steering operations, thus eliminating the need for transmitting power through universal joints.

What's even more important, said Heiple, the steering control of the Tournatow permits making turns in tight quarters.

Why Not Gas Turbines

To another future-minded engineer, the gas turbine has interesting possibilities as a powerplant for earthmoving machines. They're not as efficient as diesels right now, agreed G. H. James, of James Construction Co., but future modifications and improvements should make them competitive. And weight saved would help to solve the problem contractors face when it comes time to move their goliath equipment from one job to the next.

Registration was handled at a furious rate as the over 800 members and guests at the Conference stepped up to get their ID cards

Relax Size and Weight Limits

What contractors really need though, chimed in Allis-Chalmers' H. W. Rockwell, is relief from the restrictive size and weight limitations set up by the various states. To comply with limitations imposed by many highway departments, it's sometimes necessary to dismantle whole units. Naturally this wastes time and costs money . . . and the taxpayer winds up with the bill since the contractor submits a higher bid for the job.

The taxpayer pays in other ways, too, added discusser Jack Hartman, of Swords-McDougal-Hartman Construction Co. Often transportability dictates that two small machines be purchased rather than one large, more economical one.

Rockwell felt that in the light of the earthmoving industry's great contribution to better highways, restrictions on moving earthmoving equipment over highways ought to be relaxed.

H. H. Harrison, of the Illinois State Highway Department, didn't see it that way. If special privileges were granted to the earthmoving industry, he pointed out, heavy freight haulers would also expect to be able to increase their axle loads. Harrison did say, however, that Illinois' highway department is making a serious attempt to provide special permits when requested. At the same time, he entered a plea that equipment manufacturers design their machines to conform as closely as possible to legal limitations.

One way to develop better earthmoving equipment is to make the most of strain gages. These gadgets can be extremely useful design tools if properly used, reminded W. T. Bean, Jr.

Paving Equipment Makers Set Goals

"Better" equipment in the eyes of machine builders and users still boils down to a simple formula—machines

that will make construction dollars go further! And makers of mixing and asphalt paving machines that put the final touches on many an earthmoving job fully recognize this, reported Barber-Greene's Roy C. Heacock.

Our objective is to design and build better equipment for constructing pavements more economically, he stated. To reduce initial and operating costs of machines, we need cheaper materials that are more resistant to wear and abrasion. These are some of the goals we're shooting at:

1. Control elements with greater accuracy and longer life under very dirty conditions.
2. Simpler and cleaner dust-handling systems.
3. Quicker and cheaper plant erection methods.
4. More portability and roadability.

Actually, the biggest challenge paving equipment manufacturers face is basic approach and arrangement, Heacock concluded. Designs could stand more standardization.

Sees Economy in Compressed Air

Speaking of economy, that's one of the best reasons for using compressed air to transmit power in the construction industry, according to Gardner Denver's D. O. Meek. A compressed air system suffers more transmission losses than an electrical system, but it frequently makes up for it in direct labor savings, he maintained.

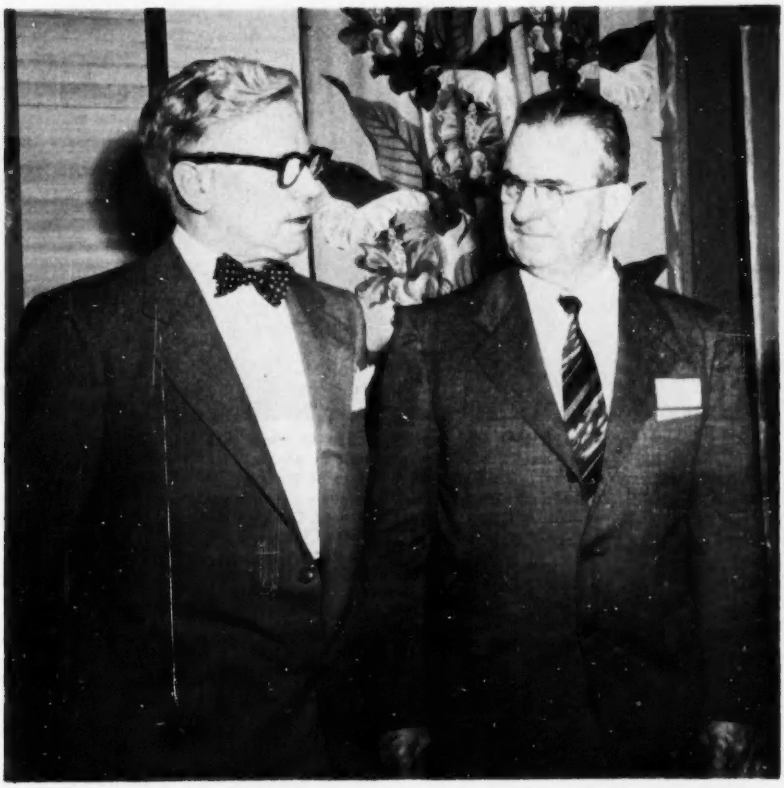
For example, a 1¼ in. capacity 2-man portable electric drill may have hourly operating costs of $4 for labor and 1¢ or less for power. Hourly costs for an equivalent air drill, which is lighter and can be operated by one man, would be $2 for labor and 3 to 4¢ for power. Thus total costs would be very much in favor of using compressed air for this application, Meek said.

Foreign Markets Tougher to Crack

But regardless of how efficient U.S. manufacturers make their earthmoving machines, they're going to have a tougher time selling them abroad, predicted Caterpillar's W. Blackie. Foreign countries that once were good markets for American goods just don't have enough U.S. dollars to buy all the goods they want. Hence, these countries must satisfy their needs as best they can from domestic or other non-dollar sources—or do without.

What's more, the few U.S. dollars they do have must be husbanded . . . and used to buy only those necessities which must come from the U.S.

But things aren't as bad as they appear, Blackie brought out. The whole process of successful business is one of adaptation to change. The fact that American business adapts itself better than foreigners to changing world conditions is, in fact, one of the major reasons for present world trade unbalance.



SAE President Robert Cass and SAE Central Illinois Section Chairman J. T. Liggett got together for a chat before the Wednesday night banquet. Speaking before the more than 550 people at the banquet, Cass warned engineers of what they may face in the future

Eight worked hard to draw 800! They were these members of the General Committee: (back row, left to right) J. A. Junck, J. C. Eirk, H. R. Johnson, T. A. Haller, H. H. Piper, (front row, left to right) K. J. Fleck, General Chairman J. E. Jass, and R. C. Barnes

At left: Robert B. Harlan (right) told Oregon Section members that the U.S. is ahead of Great Britain in the development of practical jet transports. Mel Gordon (left) was technical chairman of the Feb. 19 meeting. At right: Five past chairmen of Oregon Section were among those attending the meeting. Left to right are E. A. Haas, C. H. Lewis, Z. C. R. Hansen, and F. D. Chapman, all past chairmen; Clarence Bear, last year's vice-chairman; Mel Gordon, technical chairman of the meeting; current Chairman C. A. Dillinger; speaker Robert B. Harlan of Boeing Airplane Co.; Maj. G. A. Smith, USAF; Ray Preston, Section meetings chairman; Col. G. J. LaBreche, USAF; and Lt. Col. R. D. Smith of the Air Force Reserve Officers Training Corps at the University of Portland

Says U. S. Leads In Commercial Jets

• Oregon Section

D. T. Saunders

Feb. 19—The United States is ahead of Great Britain in the development of jet transports for commercial airlines, in spite of appearances, **Robert B. Harlan,** Boeing engineer, told members of the Oregon Section at a dinner meeting in Portland.

The British Comet jet transport has been flying more than two years and is now operating on scheduled flights between London and Johannesburg. It carries 30 passengers about 1500 miles. The Comet III, designed to carry 58 to 71 passengers, will not be in production until 1956 and is not a competitor of the jet transport now under construction at Boeing's Seattle plant and scheduled to fly by 1954.

Boeing's jet is under wraps, but it follows the swept-wing pattern of the B-47 and B-52 bombers. It is estimated to have speeds up to 600 mph at 40,000 feet or more. There will be no noise, no vibration, and no sense of speed. The cabin will be conditioned to prevent pressures on the ears.

However, it will be 1957 or 1958 before tickets can be bought for flights on sonic speedliners. Boeing is the only company actually building a jet transport for commercial use.

Government subsidy in England explains why we are seven years behind the British in use of jets for commercial aviation. Boeing's jet is company financed, and its cost is estimated at between $20 and $30 million.

We are not using Comets here because they cannot be operated at a profit; and private airlines obviously must make a profit. We can overcome England's lead, however, because of our greater resources, facilities, and experience in jet production. Boeing has produced 350 B-47 6-jet bombers, more than any other company in the world. It will be only a matter of time before the United States will surpass all other countries in the production and use of jet transports for airline use, Harlan concluded.

Design Factors Of Highway Brakes

• Kansas City Section

Samuel Melo, Field Editor

March 13—"Without highway transportation our defense production could not function, because highway transportation moves more persons and more freight than all other forms of transportation combined." This quotation from "Roads to National Security" provided the opening sentence for **Paul J. Reese,** manager of application engineering of the Wagner Electric Automotive Division, who then said that brakes are the greatest single factor in highway safety.

The functions of automotive brakes are to reduce speed, to stop the vehicle and hold it at rest. Three basic elements are involved, each with certain definite limitations insofar as performance and design of brakes are concerned: (1), the vehicle itself, which determines adequate capacity for its weight and speed; (2), the driver, who has very definite physical limitations which must be considered when designing a brake system; and (3), the road and its surface, plus the tires used or available, which dictate design possibilities and limit the braking performance of a system.

Road tests have shown that the coefficient of friction of new tires on brushed dry concrete may reach unity at low speed, which means that a retarding force equal to the maximum anticipated weight on the wheels would be needed for maximum braking. These tests also show that the coefficient of friction decreases as the speed increases, until at 50 mph it is only about 75% of its value at speeds below 10 mph.

It has also been demonstrated experimentally that maximum braking is achieved just before the wheels slide. Under extreme conditions, such as packed snow or ice, the coefficient of friction may be reduced to 10% of unity. This wide variation must be taken into account in distributing the braking torque between front and rear wheels. Proper distribution of braking has a pronounced effect on the maximum deceleration obtainable without sliding of wheels, particularly at high speed, but front wheel skidding on ice and consequent loss of steering limit the amount of front braking usable on icy roads to a percentage of total braking which reduces the maximum braking performance at high speed on favorable road surfaces. The final solution is, therefore, a compromise based on tests and past experience.

In designing the braking system for a vehicle, the following information is required: (1), Weight on each wheel; (2), Loaded rolling radius of

tire; (3), Rated speed with rated load; and (4), Type of service.

Weight and speed determine the torque output and the heat capacity of the brake required. The torque output of a brake in inch/lbs is equal to the Input × Radius of Drum × Coefficient of Friction between the lining and the drum × a Brake Factor (determined by the design of the brake). The heat absorbing and dissipating capacity of a brake and its drum is determined by, (1), type of brake; (2), size; (3), location; (4), clearance between drum and wheel; (5), materials.

Actuating mechanisms using rods, cables, and so forth, have been almost totally superceded by hydraulic or air systems in present automotive equipment. The usual specifications laid down by vehicle manufacturers are that the vehicle must be capable of making a legal stop with rated load (30 ft from 20 mph) at some specified hydraulic or air line pressure. If this pressure is not easily attainable through physical effort, it is necessary to provide power assistance through a vacuum booster or Hydrovac, air booster or full power actuation of the brakes with air-hydraulic, or straight air.

Further considerations of driver comfort have prompted manufacturers of passenger automobiles to use power-assisted brakes, of which several types are now in use or have been tried, namely: vacuum, compressed air, electric and hydraulic. The type of power employed is determined mainly by economic considerations.

Stresses Need For Diesel Improvement

• Texas Section

W. B. Tilden

April 2—Speaking before the Houston Division of Texas Section, SAE President **Robert Cass** stated that both truck and passenger car engines must be designed better, so that they can take care of engine deposits which are becoming a problem in the engine horsepower race.

He further stressed that diesel engines must be made more efficient in order to compete with gasoline engines. Because of higher fuel costs in certain areas on diesel fuel, the diesel engine can no longer operate as economically as the gasoline engine. This fact probably accounts for the decrease of 12% in diesel production during 1951 and of 7% in 1952, Cass stated.

Cass also warned that automotive engineers must find substitutes for vital metals such as nickel and cobalt, as these metals are being taken from civilian industry by the Government's mobilization program. Some engine radiator manufacturers are now experimenting with aluminum radiators, he added.

Gas turbines must be improved in design so that they can be produced at a reasonable cost and will operate on distillate type fuels at much lower consumption rates, Cass said.

Cass was presented with a certificate signed by Governor Allan Shivers of Texas, stating that he is now a Citizen of Texas. He was also made a deputy for Houston and was presented with his badge of office by Chief Deputy Williams of the Sheriff's office.

Diesel Care In Cold Weather

• Twin City Section

D. D. Hornbeck, Field Editor

Mar. 11—"Engine users must learn to understand that low-load, low-temperature operation imposes more severe contamination conditions on their equipment than would be experienced during summertime, even in continuous full-load service, and the proper remedies cannot be provided by the engine manufacturer, but are in their own hands," advised **H. M. Gadebusch**, of GMC's Detroit Diesel Engine Division.

Speaking on "Diesel Engine Operation at Subzero Temperatures," Gadebusch said that the problems presented to operators of diesel-powered equipment during the cold season cannot be met by a simple solution. The selection of low-sulfur fuels with high ignition quality and good vaporization characteristics is only the first step towards satisfactory operation.

In subzero weather, idling or light load conditions must be restricted to a minimum and overcooling of the engine avoided at any cost. Whenever extremely cold ambient temperatures combine with the use of high-boiling fuels of excessive sulfur content to create extraordinarily high sludging conditions, it may be necessary to resort to oils of the highest detergency level.

The ignition quality of suitable cold weather fuels must be high enough to avoid misfiring. Puffs of white exhaust smoke are indicative of such cutting-out of one or more cylinders as results in the injected fuel not even being ignited, thus contributing in full to the ill effects of incompletely burned fuel fractions. A plentiful supply of fuels with cetane numbers of around 50 are available in the ASTM No. 1-D volatility range. Where local conditions prohibit the procurement of fuels of high enough ignition quality, resort to addition of the commercially available chemical cetane number improvers may be necessary.

With their interest stimulated, the 145 members in attendance engaged in a lively question-answer session. Much favorable comment was heard regarding the talk.

Explains Growth Of Power Steering

• Williamsport Group

Paul Cervinsky, Field Editor

April 7—Power steering is entering the automotive field more strongly because of changes in tire sizes, lower inflation pressure, tripling of steering ratios and changes in weight distribution, stated **Francis W. Davis**, consultant engineer, before 35 members and guests of the Williamsport Group.

Although power steering ideas are not new, it was not until World War II that serviceability and trouble free operation was proven with this type of steering when used on most heavy duty equipment. With the advantages of better manufacturing operations, improved high pressure hoses and new type O ring seals, successful results are assured. The steering mechanism

Cass Visits Met Section

Vice-Chairman Charles E. Chambliss, Jr. (left), of Metropolitan Section's Passenger Car Activity, with SAE President Robert Cass and Francis W. Davis, who described the development of various types of power steering devices at the Section's Feb. 5 dinner-meeting

reverts to manual operation if the highly improbable failure of the power steering unit occurs.

Davis concluded by saying that:

1. Power steering will be the next major improvement in the automotive industry to sweep the field.

2. The luxury and ease of power steering offset the small additional cost.

3. The choice of the type of power steering will be decided by the customer.

4. Lastly, power steering will take its place in the American way of life as long as people want to go some place sitting down.

Bradley Students Conquer U. of Illinois

• Central Illinois Section

R. B. Applegate, Field Editor

March 23—The SAE Student Branch from Bradley University again defeated the University of Illinois in a debate at the March meeting of the Central Illinois Section. The Bradley team defended the resolution, "Resolved: That torque converters are an essential component of future power transmissions." Almost 200 members and guests enjoyed the spirited presentation.

The judges were E. W. Jackson, vice-president, Caterpillar Tractor Co.; F. L. Cockrell, assistant general secretary, Y. M. C. A.; and W. F. Shurts, director of engineering, Twin Disc Clutch Co. They evaluated the quality of debating on the basis of preparation and delivery without regard to the merits or truth of the resolution.

In presenting the advantages of a torque converter, the Bradley team brought out such points as less maintenance of power train, high efficiency, multiple gear ratio, less driver fatigue, less shock and torsional vibrations transmitted, prevention of engine stalling, high starting torque and high torque output at low speed, and adaptability to inexperienced drivers. They summed up their arguments by showing the adaptability of torque converters to off-highway trucks, pusher tractors, shovels, and so forth, stating that any machine with a load factor higher than 18% is more efficient when equipped with a torque converter.

In attempting to show that torque converters are not essential, the University of Illinois team brought out such disadvantages as cooling problems, higher initial cost, more bulky units, and higher fuel consumption. They stated that torque converters have no advantages in such applications as farm tractors, conveyor belts, ships and other machines where the load factor is constant. Load shocks and torsional vibrations to the power train can be cushioned by means other than a torque converter; for example, by use of a fluid coupling with the Hydra-matic and other automatic transmissions. Some of the advantages of the Hydra-matic transmission over the torque converter brought out were: no cooler necessary, higher efficiency, low slip, 30% better engine braking, lower fuel consumption, and 62% of the power transmitted mechanically.

They also stated that an experienced operator can operate a conventional transmission at efficiencies higher than the torque converters, and brought out that torque converters are not essential because of such flexible drives as gas and steam turbines, diesel-electric drives and steam engines.

Technical chairman for the meeting was W. C. Van Dyck, assistant manager, education and training department, Caterpillar Tractor Co. The coffee speaker was F. H. Norris, field research engineer, Caterpillar Tractor Co.

Give Tips On Gas Economy

• St. Louis Section

E. E. Wallace, Field Editor

March 10—"168.5 miles per gallon is possible"—this was the theme of discussion by a panel of Shell Oil research personnel at a joint meeting of the St. Louis SAE and ASME Sections.

The panel consisted of **W. N. Blatt, W. D. Simms, R. G. Tuell, E. Isringhaus** and **D. Barry** with direction and moderation supplied by **Dr. L. S. Echols** and **R. J. Greenshields.**

The means of improving fuel economy were discussed by Dr. Echols, who presented data showing the cumulative effects of reducing various vehicle frictional losses in the engine and drive train, reducing rolling and windage losses, and improving the specific fuel consumption of the engine by modifications.

The history and the regulations governing Shell's annual "Mileage Marathon" were also covered by Dr. Echols.

The panel members, all of whom have participated in the Marathon, then discussed how the various factors affecting economy were applied their cars.

Modifications for reduction of friction and rolling resistance usually consist of inflating tires to high pressures, removing portions of the tire treads and using light oils for engine, transmission, differentials, and wheel bearing lubrication. Transmission gears not needed for the Marathon run are sometimes removed. Special carburetors with manually controlled mixtures are used by some contestants. Many of the older model cars have had compression ratios increased.

The greatest boost in Marathon mileages has followed the introduction of intermittent engine operation. The contestant accelerates at full throttle to a desired speed, usually about 25 mph, shuts off his engine and coasts until the speed drops to approximately 10 mph. Thus the engine is used only at its most efficient operating condition.

Following this system, the coolant temperature is kept low and fans may be eliminated. On some cars it has been necessary to water-jacket intake manifolds in order to obtain optimum fuel vaporization and mixture distribution.

Using most of the above aids, a 1924 Chevrolet attained an actual score of 168.47 mpg in the 1952 Marathon. Although results are converted to a "corrected mpg" based on a 3500 lb car weight for rating purposes, this car still turned in a corrected 146.88 mpg at an average of 14.9 mph. In a second class in which the average speed must be above 30 mph, a 1951 Nash Rambler gave an actual 74.49 mpg at an average of 30.6 mph.

In answer to the question of what the average driver can do to improve fuel economy in the family car, the panel listed proper maintenance of carburetion, ignition timing, valves, sparkplugs, tire inflation and steering geometry as factors affecting any vehicle's potential economy, and proper driving habits of moderate road speeds, avoiding "jack-rabbit" starting, and maintaining a constant throttle position as means of obtaining economy.

We try . . .

. . . to bring you live, prompt news of Section meetings in these pages. Section Field Editors do their best to cover every meeting.

This issue covers all Section meeting reports received in New York by April 12, our deadline for the publication date of May 5.

Presidential tour takes Cass to Kansas City, Philadelphia

At left: Speaking March 30 at Kansas City Section, President Robert Cass gets a smile from Section Chairman L. C. Mecklenburg. At right: In his March 11 visit to Philadelphia Section, Cass dropped in at Piasecki Helicopter Corp. in Morton, and heard Lee Douglas, vice-president of engineering, explain the landing gear of the new Air Force H-21 "work horse" 'copter . . . Monroe Brown, assistant to Piasecki Chairman Frank Piasecki, is at right

Jet Engine Combustion Problems

• Southern New England Section
A. D. Nichols, Field Editor

April 2—The specific fuel consumption of a ramjet engine is almost identical to that of a turbojet engine, said **Dr. J. P. Longwell** of the Standard Oil Development Co.

The major combustion problems are stability, the ability to maintain combustion over a large fuel consumption, pressure and temperature range, and attainment of satisfactory efficiency in a reasonably small volume.

The types of combustion which are carried out in a ramjet are diffusion flames, premixed flames, and homogeneous combustion. Diffusion flames are typified by a candle or kerosene lamp flame. Homogeneous combustion is obtained by carefully controlling the mixing of fuel and air. Premixed flames are much shorter and are produced by mixing the fuel and the air before ignition. Of the three types, homogeneous combustion has the highest rate of combustion.

The rate of consumption of fuel is proportional to the product of concentration of fuel vapor and oxygen and this rate decreases with temperature decreases. Lower rates of combustion are experienced when the pressure decreases and when the fuel-air mixture is either lean or rich.

A recirculation zone has been found to be the most effective means of supplying a constant and strong source of ignition in the fast moving mixtures of fuel and air. A baffle or flame holder behind which this recirculation zone exists stabilizes the flame in this high velocity air stream. However, improper mixture or too high rate of air flow will cause blowout. The problem of burning the entire mixture that flows past a baffle determines the length of combustion chamber required.

The situation where chemical reaction rate is limiting is much simpler to treat than where the details of the mixing must be considered. Wherever the details of turbulence are important, relatively little progress has been made in prediction of performance. It is, however, valuable to know the limits as set by kinetics, since it sets a goal toward which the development engineer can work.

Tape Recordings Aid Engine Noise Tests

• Milwaukee Section
P. S. Myers, Field Editor

Apr. 3—"Engine Harshness in Passenger Cars" was the title of the talk presented by **Gerald Klaasen** of the Central Engineering Division of Chrysler Corp. Klaasen not only talked about engine harshness, but also brought along tape recordings of engine harshness illustrating its harsh unpleasant staccato noise and showing the effect of various changes in the engine on the noise.

In studying engine harshness, the first step was to determine the frequency range in which the objectionable noises were found. Tests showed the most objectionable noises to be in the 300-600 cps second range. After listening to the noise in the frequency range it was concluded that the repetition rate was one-half order and an attempt was made to simulate the noise electronically by exciting a tuned electrical circuit with a square wave of one-half order frequency. After comparing the synthetically-produced noise with the noise produced by the engine, it was concluded that, although they did not sound exactly alike, engine harshness could be identified with this simple type of synthetic wave form.

Since this wave form suggested a system vibrating at its natural frequency under the influence of repetitive excitations, an arrangement was constructed that permitted a heavy weight to "bang" the crankshaft. The recorded frequency was in the 300-600 cps band. Various resilient backings for the main bearings were tested but the thickness and softness of the backings required prevented their use, Klaasen said.

In order to study the vibration more naturally, the flywheel was locked in place, a cylinder was filled with oil and

pressure impulses were sent into the cylinder by means of a diesel fuel injection pump. It was found that maximum crankshaft deflection occurred when the rear crankpin was loaded.

As a result of these tests crankshaft damping was tried, and the recordings showed that appreciable improvement was obtained. Attention was also directed to the combustion chamber shape, since the combustion pressures must be the exciting force; a different design of combustion chamber was developed that gave less harshness.

In the combustion chamber design studies it was found that retarding the spark always decreased the harshness but decreased the power also. When the power was increased again by raising the compression ratio, however, the harshness was lessened.

The pressure-time diagrams were next studied to see if the exciting frequencies were present by feeding the output of the pressure pickup into the tape recorder. Little evidence of exciting frequencies was found. Studies were also made of the means of mounting the torque converter to the crankshaft, since it had been found that the harshness was often more noticeable with a torque converter. Although a rigid mounting increased the general engine noise, it decreased the engine harshness.

The discussion period brought out that harshness is most prominent at medium engine speeds and loads and that while it is not harmful to the engine, the customer sometimes thinks the bearings are bad and objects. At higher speeds and loads, other noises overshadow the harshness and it is not noticed. Bearing clearance was found to have practically no effect on harshness.

It was also pointed out that while a torsional damper might help some, it aids primarily by virtue of its mass rather than its damping since this is a bending vibration. All of the six-cylinder engines tested seemed to have their objectionable noises in the 300-600 range, but since the five-bearing V-8 did not seem to have objectionable harshness, it was concluded that its frequencies might lie in a different range.

Klaasen also mentioned that car recordings were tried but were unsuccessful because of background noise. Thus the tests reported were run in a sound-proofed room with the microphones made partially directional by shielding and placed within a few inches of the engine.

Design for Production, Tool Engineer Advises

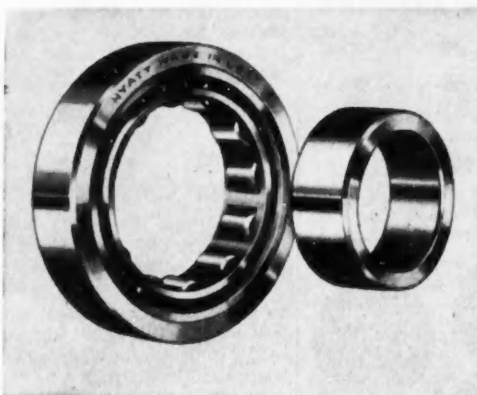
■ Mohawk-Hudson Group

Knud Antonsen, Field Editor

April 7—"Modern machine tools help us produce better, faster and cheaper," stated **E. W. Dickett** of the Sundstrand Machine Tool Co., in his paper on "Machine Tools and the Engineer." The talk was illustrated by several samples showing old and new manufacturing processes applied.

"When designing new parts," said Dickett, "the engineer can help ease the manufacturing operations in many ways." Centers on shafts, for example, should be shown and dimensioned. Sometimes it is even possible by simple adjustments to design shafts with integral driving lugs so that the part can be completely turned on a lathe in just one setup.

Dickett emphasized how important such preliminary work is. On castings, for example, mounting pads



should be called for when milling operations are required.

The use of automatic chucks, both the magnetic type and those operated by compressed air, was described.

A film entitled "Engineered Milling Production" was shown. It illustrated how standard milling machines can often be equipped with special fixtures and jigs to mass-produce complicated parts, and in many cases can perform several operations in the same setup.

Just recently returned from a nine weeks trip to Europe, **F. R. Swanson**, director of the machine tool engineering department, Sundstrand Machine Tool Co., spoke about his visit to two machine tool shows. One was the Olympia Machine Tool show, held in England; the other was the Hanover Machine Tool show in Germany.

European machine tools are often built lighter than those made in this country, Swanson said. A good appearance seems to be important in the European designs. The workmanship, especially that of Swiss, Swedish and German products, is of high quality. None of the European tool manufacturers, however, seem to threaten the lead this country holds in designing and producing modern mass production machine tools.

Swanson also gave the group his impressions of visits to manufacturing plants in seven countries, illustrating the tremendous task it has been to bring European industry back on its feet after World War II.

Harry R. Leber, sales manager, and C. H. Engberg, sales engineer, both of Sundstrand Machine Tool Co., accompanied Dickett and Swanson on their visit to the Mohawk-Hudson Group.

Due to the late hour, no question period followed the talks and film presentation.

Predicts Smaller Cars

• Wichita Section

Jay H. Whoolery, Field Editor

March 31—SAE President **Robert Cass** was accompanied by Hollister Moore of SAE Headquarters, who made a short talk after dinner.

Cass first gave a short talk on the history of Wichita Section. Turning to the national scene, he said that we are in a shortage of material and that the military demand from now on may cause a still shorter amount for public consumption. Copper is especially short, and most of our copper must be imported. If much ammunition is required some substitute must be found.

Nickel also is rare. Most of it is gone from use on automobiles. There used to be an average of 5 lb on passenger cars; now it is down to about $1\frac{1}{2}$ lb. If military needs go up, it will probably be eliminated from such use entirely.

Cass also commented that our pres-

ent type of heavy car is most inefficient due to the lack of full power use. Cars are used mostly to and from work. He asked how high hp and heavy weight can be justified when a recent test of city driving showed the power developed for normal use to be around 7 hp for cars. He forecasts that cars may come down to less than 90 hp and weigh less than 2000 lb in the not-too-distant future. These cars will be designed for at least five passengers.

Cass also stressed the part of engineers in future business. The engineering group should take more part in the business end, he said, and be in on plans for production as well as sales.

He answered questions from the floor as follows:

"What is being done about higher speeds and higher hp in trucks?"

Answer: California now is cutting back on power. This truck power was up to 350 hp. Now it is settling back to about 200 hp. This is partly because of efficient use of the engine, as well as plans in the future for lesser grades on highways and more direct highways. Such construction will go a long way toward cutting operating costs.

"Why don't we have the small car now?"

Answer: People want what they now have. In a boom time, people seem to like and want heavier and heavier cars.

"Why don't we have plastic cars now?"

Answer: It is doubtful if we will have plastic cars for some time. At present they are being built only in small numbers and are more or less of the special built, sport car class.

Tells of Advantages Of Boeing 502 Turbine

• Salt Lake Group
J. P. Bywater, Field Editor

March 2—Projection slides showed the performance characteristics of the Boeing Model 502 turbine in its application as a powerplant in the Kenworth truck chassis, while it was described by **William P. Barnes**, assistant professor of mechanical engineering at the University of Utah.

Of major interest was the exceptionally high starting torque obtained through separation of the first and second stage turbine wheels. Under this arrangement the compressor shaft may turn at the maximum rated speed of 36,000 rpm while the power output shaft is at stall. A starting torque in excess of 600 ft-lb can thus be obtained. With this unique powerplant-torque converter combination, a high braking effect is possible for use on downhill grades, Barnes said.

Additional advantages of this versatile engine in the transportation field listed by Barnes included:

(1) Lightweight and small displacement, giving payload increases up to 3000 lb.

(2) Reduced maintenance problems.

(3) Good cold weather starting with high volatile fuels.

(4) Maximum fuel economy with maximum engine output.

(5) Clean and odorless exhaust.

(6) Absence of an external cooling system.

(7) Adaptation to many low-grade, non-explosive fuels.

The major drawback to present gas turbine usage is its high specific fuel consumption as compared to that of reciprocating engines. One method presently under consideration for improving thermal efficiency consists of regeneration whereby heat from the exhaust gases is used to increase compressor air temperature prior to its induction into the combustion chambers. Higher compressor efficiencies are also anticipated through use of multi-stage compression and improved compressor design. Increased combus-

tion temperatures will be possible through the use of better heat resistant metals and more efficient turbine blade cooling.

The meeting was concluded with showing of the Boeing sound film on the Model 502 gas turbine, showing its development in conjunction with the U. S. Navy and installation in the Kenworth truck and Navy speed boat.

Cut Down Waste, Cass Urges Engineers

• Pittsburgh Section

A. E. Slagle and R. L. Sailer

Feb. 24—After dinner at the February meeting of Pittsburgh Section, **John Hollis**, manager of SAE's administrative division, spoke briefly on the value of membership in SAE and participation in its activities. The meeting then adjourned to the Mellon Institute Auditorium, where Past-President R. J. S. Pigott introduced President **Robert Cass.**

Cass described new materials such as titanium as one of America's new "engineering frontiers." Our present materials too are taking on new roles —particularly steel, copper and aluminum. Aluminum is taking on many jobs formerly done by copper, such as electrical wiring and radiators. The ratio of copper to steel is decreasing, while that of aluminum to steel is increasing almost in direct proportion. Our increasing population, in relation to our total supplies of each material, is bringing about these changes, Cass said.

If we are to maintain our present high standard of living—in view of our increasing needs and static resources—we must eliminate waste from our economy, Cass continued. As an example of our tendency to use more than is needed to do a job, he cited a recent test on modern passenger cars, which gave startling results. A fleet of 160 hp cars, operating under city driving conditions, showed:

0.2% full throttle operation
50.1% part throttle operation
49.7% closed throttle operation
1800 rpm maximum speed
982 rpm average speed
19.4 in. mercury average manifold vacuum
17.0 mpg

Since many cars are used exclusively or mainly for city driving or similar conditions, we should make available a lighter, more economical car, Cass feels. But, he added, this probably won't come about until forced upon us by economic pressures or material shortages. In present cars, there is still plenty of room for improvement in fuel consumption and length of life through pressure cooling systems, cleaner engines and reduced heat losses.

Cass covered the gas turbine and its possible application to ground transportation, the diesel and its problems in this country, and, finally, the probable influence of a civilian atomic and chemical technology on our civilization. He emphasized that engineers must take more responsibility in leading society to a new and more satisfactory life compatible with our advancing technology.

The lively discussion period centered around the possibilities of a small American car. Many members felt that production is the lifeblood of our economy, and that anything that might tend to curtail it would have a detrimental effect on the economy.

Tells of Development Of Automatic Transmission

• Western Michigan Section

A. L. Maring, Field Editor

March 17—**Walter B. Herndon**, director of engineering and sales for Detroit Transmission Division of General Motors Corp., presented a talk entitled "Four Million Hydra-Matics."

Herndon traced the history of the hydra-matic transmission from its beginning in 1932 up to and including the new 1953 model. At first an automatic transmission was a luxury, but now one out of every two cars made has an automatic transmission of some sort. Oldsmobile was the first to use the hydra-matic and had it on its 1940 model cars. When the Detroit Transmission plant was getting started, their goal was 240 transmissions per day; it has grown until now they are manufacturing 4,000 transmissions per day. The 4,000,000th transmission was manufactured in January of this year.

Detroit Transmission furnishes the hydra-matic in several different designs to ten customers, including Muntz and Rolls-Royce. The hydramatic is currently used in twenty-one different models, and Oldsmobile, Cadillac, and Lincoln are now using hydra-matics on 99% of their production.

The original aim of the hydra-matic was to meet or beat the performance of the syncromesh transmission. This was accomplished by designing more transmission and by having four speeds instead of the usual three. The fluid coupling gives a good smooth start, but is too efficient at low speeds, causing creep, and too inefficient at high speeds. These troubles were licked in the later model hydra-matics by having a controlled fluid flow at different speeds.

The changes necessary to make all of the models required for the present

21 applications are not as great as expected, because there is a basic design which is carried through for all models. The changes necessary are all internal and involve the use of more or less clutch plates, changes in fluid pressures, and split-torque fluid coupling.

There have been many improvements in the hydra-matic that have resulted in a weight saving. Two examples are a weight saving from 13½ lb to 8¾ lb in the fluid coupling and a saving from 21 lb to 15 lb in the flywheel.

Another interesting development is the change from a gear pump to an internal gear pump, and then to the present variable capacity pump that is used on the new dual range hydramatics. The new dual range hydramatic includes the advantages of overdrive along with automatic shifting. The dual range also has better braking qualities for mountain driving.

Herndon stated that there will definitely be continued improvements in the hydra-matic transmissions, but that they will be gradual and not too drastic because of the tremendous investment in equipment, plants, and so forth. He predicted that the future will see still lower axle ratios to keep the engine speed down and a greater use of gears for more efficiency.

New Applications For Power Actuation

• Detroit Section

George J. Gaudaen

March 30—Power actuation of body equipment components, a major trend in the automobile industry, was the subject of a panel discussion sponsored by the Body Activity of the Detroit Section. Panel members represented views favoring each of the major actuating means: electrical, hydraulic and vacuum.

Participating in the discussion were **E. C. Horton**, chief engineer of Trico Products, covering the vacuum methods; **Paul B. Best**, general sales manager of Hupp Corp., discussing the electrical devices; and **John Parsons**, chief engineer of the hydroelectric engineering department of the Dura Division, Detroit Harvester Co., who spoke on the hydraulic actuated systems. **R. D. Brewer**, supervisor of the electrical laboratories section of the engineering department, Ford Motor Co., acted as the panel moderator.

While each of the participants presented the case for his method, all were agreed that increased consumer demand for car safety and comfort is rapidly increasing the number of applications where power devices are replacing manual operation of moveable

body components. Best noted that among other things the electrical units are being used for window regulators, convertible top lifts, seat adjustors and antenna lifts, with other applications being considered. Parsons noted that in prospect for future applications were devices to operate the parking brake, raise and lower the trunk deck lid, to open and close ventilator windows and a door locking mechanism which would make it possible to securely lock any door in the car from the driver's seat. Horton reported that his organization has under consideration a system using a full-time rotary engine-driven pump which would serve not only to operate all of the various vacuum devices on the body, but also ventilate the crankcase, under all conditions of operation.

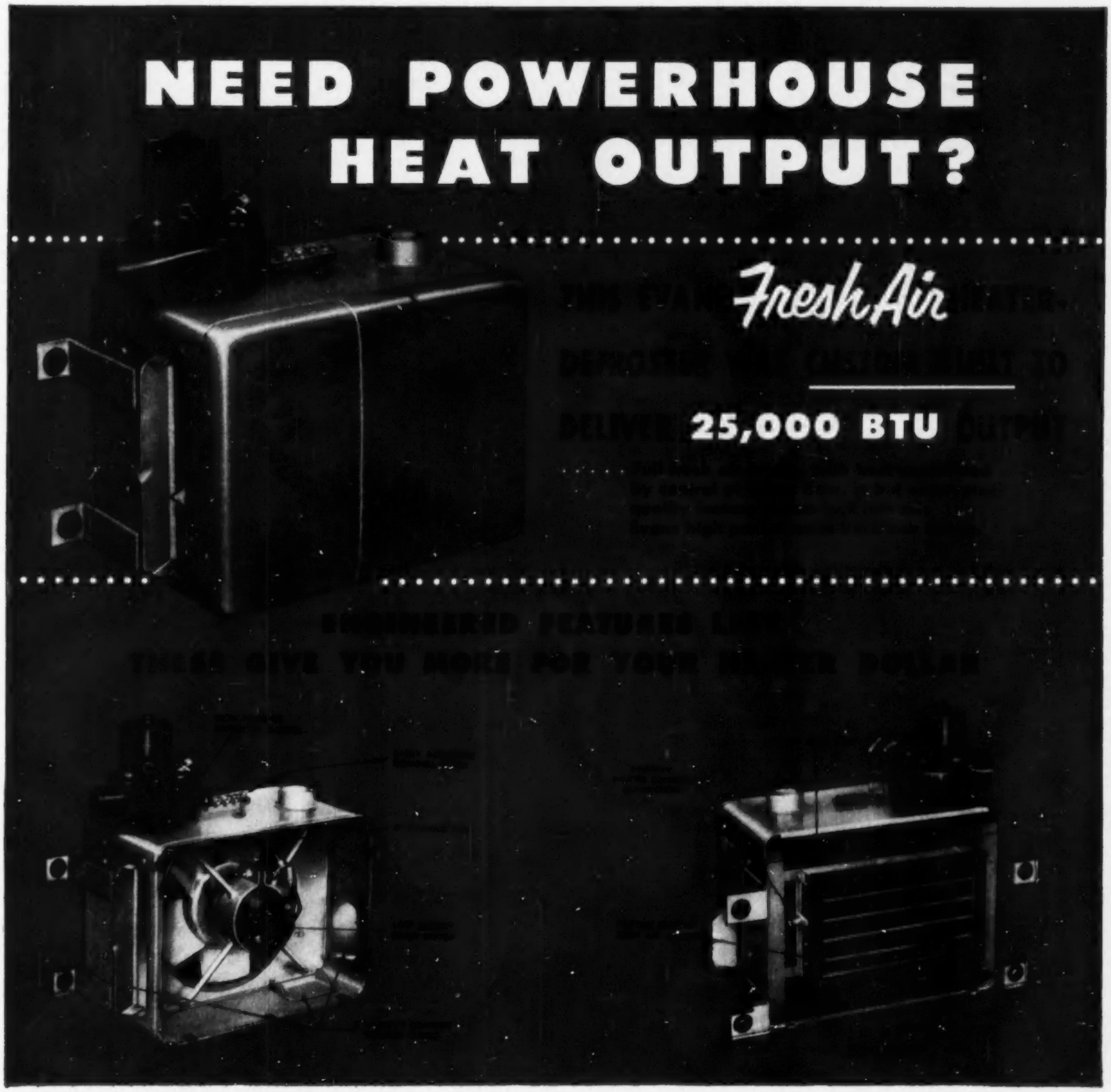
A considerable portion of the discussion centered on the various means used to raise and lower automobile windows without manual exertion. The speakers noted in their individual reports that regardless of the method used, the systems have a number of points in common in their performance. Thus, they are generally designed to place 40 to 50 lb of thrust on the window in moving it from a completely lowered to a completely closed position. Also, each of the devices permits the window to be raised manually when necessary but locks so that the window can be lowered only by use of the power device. A third similarity exists in that all devices use some type of electric motor to initiate the action.

Horton described how the vacuum device accomplishes the window regulating operation by harnessing the engine vacuum pressure through the means of a double acting, self-locking piston. Low amperage is used to crack open an air port in a tube in which the piston is located, he said, and atmospheric pressure then enters to push the window in the desired direction. He reported that a stand-by unit in the form of a motor driven compressor is used when the engine is shut off or in the rare instances when the throttle is wide open.

The general practice with the electrical systems, Best stated, is to use an electric motor to drive a worm and pinion gear which in turn drives a sector gear to operate the window mechanism. The control switches in the door panels are connected to operate relays which make and break the motor current, he said.

It was noted in Parsons' paper that operation of the hydraulic actuating system is accomplished through a regulator located in each of the door panels. These regulators consist of a piston-cylinder arrangement in which the piston is moved through the use of a lubricating fluid. Movement of the fluid is accomplished by the use of a single oversized electric motor.

With but minor variations, the window regulating devices are used in the operation of the other moveable body components.



EVANS ENGINEERING IS AVAILABLE TO HELP SOLVE YOUR PROBLEM

Evans automotive heating and ventilating equipment is engineered in detail for each individual installation. Experience proves that only with such custom construction can a truly satisfactory heating and ventilating system be devised for the wide variety of commercial cars, trucks and buses now on the road or on the drawing board.

The Evans organization is staffed to engineer promptly an installation to your specifications, organized to build prototypes quickly, equipped to conduct precision tests to latest A. S. H. V. E. procedures. Military experience dating back to World War I qualifies Evans to work well with you in meeting the rigid specifications of the Armed Forces. If your needs are for high performance, ruggedly constructed automotive heating and ventilating equipment—custom built to your specifications—it will pay you to consult *Evans Products Company, Heating & Ventilating Division, Dept. Z-5, Plymouth, Michigan.*

BALANCED HEATING & VENTILATING

CUSTOM HEATERS

FOR EVERY TRUCK AND BUS

Automation Lifts Burden From Worker

Based on paper by

SWAN E. BERGSTROM

Cincinnati Milling Machine Co.

FORTY years ago the flat surfaces of an automobile cylinder head were machined at a rate requiring 162 machine tools to produce 108 pieces per hour. Five years ago the same output could be produced with six machines, thanks to the advance in both machines and cutting tools. Today, one new 90-ton broaching machine alone can produce 137 pieces per hr.

This new broaching machine can develop a peak power output of 450 hp and remove 1200 lb of metal per hr. That's 100 times the removal possible with the machine tools of 50 years ago. It is operated by push button and lever controls, by a single man, and proceeds automatically through its cycle, which covers clamping work, removing metal, unclamping work, moving work to rollover and then from conveyor to fixture, in only 21 sec.

With this rise in production the direct wage cost per piece has dropped from the 40¢ of 40 years ago to the present 4¢ per piece, a gain paralleled only by the saving in human effort. This is automation—the art of applying mechanical devices to manipulate work pieces in and out of machines, turn parts over between operations, remove scrap, and to perform all in time sequence with the production equipment so that a production line can be wholly or partially under push button control at strategic stations. (Paper, "Machine Tools," was presented at the Centennial of Engineering, Chicago, Sept. 5, 1952. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers).

Accessory Mounting Offers Tough Problem

Based on paper by

J. E. GLIDEWELL

ACF-Brill Motors Co.

TO arrange an engine so that any and all accessories can be provided for on the final assembly is an absorbing problem. It partially explains the expense of building an engine. But since all accessories have a particular purpose we shall continue to hang them on the engine.

Certain limitations must be kept in mind when positioning units on an engine. In the first place, all highway vehicles are limited to 96 in. width over front wheel hubs. This limits frame width and, in turn, the width of engine mounting space in the frame. When more horsepower is required for a larger vehicle, the engine must produce it without requiring an increase in lateral space. And in conventional jobs, room must be provided on the left side, just forward of the flywheel housing, for mounting the steering gear.

The depth of lower case or oil pan is another limitation. It must allow clearance over the front axle. This has the advantage, of course, of placing the oil sump to make the oil drain plug more inaccessible.

Frequently the space for engine length is just a little shorter than the engine. If the space is otherwise adequate it may be possible to mount something on the fire wall above the

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An engineering and design service that has the answer to your carburetion problems; the finest in production facilities; quality service, with a reputation for eliminating customers' production "bottlenecks."

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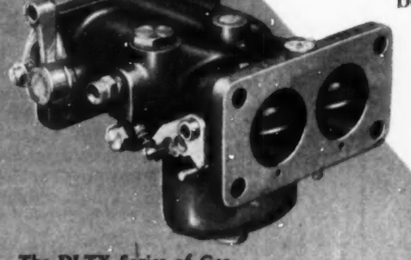


The DLTX Series of Gas Carbureters for Tractors

LP Gas Carburetion Systems for Truck and Tractor Conversion

Power Brakes for Trucks

MARVEL-SCHEBLER *Products Division*
BORG-WARNER CORPORATION • DECATUR, ILLINOIS

engine so that it has to be unmounted before the engine valve cover or cylinder head can be removed for adjustment.

Hood height on conventional trucks imposes some limits on engine height. It is rare to have enough room to put the air cleaner under the hood. This complicates air piping, but has the advantage of providing cooler air and greater accessibility for servicing. The C.O.E. type of truck has its own clearance problems.

Still another limitation is the necessity to mount accessories above crankshaft center in order to clear frame members and provide accessibility.

When possible, it is best to mount accessories on the left or intake side of an engine because the exhaust side can get very warm. And the exhaust should be on the right because driver and steering gear are on the left. This makes the driver more comfortable and allows the exhaust pipe to run through a space free of steering mechanism.

Space limitations alone lead to the conclusion that the only place for accessories is on the left side, forward of steering gear, above frame side member, and below height of engine valve cover. Obviously, not all accessories can be lashed on in that area and so there must be encroachment on other spaces. (Paper, "The Internal Combustion Christmas Tree—Or Why Shouldn't an Engine Have More Accessories," was presented at SAE St. Louis Section Meeting, St. Louis, Dec. 9, 1952. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers.)

Large, Low Speed Engine Is Economical

Based on paper by

T. H. MITZELFELD

General Motors Corp.

TO determine the effect of engine size on fuel economy, two 331 cu in. V-8 research engines were put under test. One engine served only for comparison, the other was equipped with a new crankshaft to give a 2.7 in. stroke in contrast to the original 3.6, thus reducing the displacement to 248 cu in.

Both engines were installed in identical cars, but the car with the 248 cu in. engine had a 4.3 rear axle ratio as opposed to 3.1 in the other. At 40 mph the engine torque is 266 and 198 lb/ft for the 331 cu in. and 248 cu in. engines respectively, but at the rear wheels the torque is 820 and 845 which is very close.

In performance these cars were well matched, but fuel economy of the larger engine averaged 5% better. Furthermore, the car with the larger

engine was more comfortable to drive. The only apparent disadvantage is the greater weight and perhaps higher first cost of the larger engine. (Paper, "Relationship of Engines to Car Performance", was presented at SAE Junior Group, Detroit, Oct. 20, 1952. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers.)

Diesel Power Makes Fork Lift Truck Safer

Based on paper by

L. C. DANIELS

Buda Co.

A DIESEL-POWERED lift truck can be started and operated without any electrical equipment. A compressed air starter or hydraulic starter motor suffices. Either one can be powered from a compressed air tank or hydraulic pressure accumulator. If electrical starting is desired, batteries can be kept outside hazardous areas, detached from the truck by a quick detachable coupling. No spark plugs are needed, hence there is no need for a battery, points, generator or other electrical equipment. What's more, dangers attendant on electric or gas power are eliminated.

Freedom from the dangers of carbon monoxide is another advantage of diesel power. Carbon monoxide content of the diesel exhaust can be reduced almost to zero, which is far below the safe limit.

Experience also shows that the percent of aldehydes increases or decreases with the fuel air ratio. When this ratio is kept below the safe limits, the aldehydes produced can hardly be detected by smell and are far below the irritation limits. In effect, then, the diesel provides an automatic carbon monoxide signal, for if operated overlong in a poorly ventilated area, the smell of aldehydes gives warning of carbon monoxide long before the concentration approaches the danger limit.

The problem of hot exhaust manifolds and gases is not as critical with diesels, too, because the more efficient combustion cycle results in lower exhaust gas temperature. Using a water muffler and proper exhaust baffling, the temperature of the exhaust gases is reduced to about 200 F at the tail pipe—a safe temperature for practically any hazardous area. (Paper, "Diesel Engines in Fork Lift Trucks," was presented at SAE National Diesel Engine Meeting, St. Louis, Oct. 31, 1952. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers).

New Members Qualified

These applicants qualified for admission to the Society between March 10, 1953 and April 10, 1953. Grades of membership are: (M) Member; (A) Associate; (J) Junior; (SM) Service Member; (FM) Foreign Member.

Atlanta Group

Fred L. Weinheimer Jr. (J).

Baltimore Section

J. Kenneth Gardner (A), Joseph J. Hock (A), Arne P. Rasmussen (M), Gordon A. Sossich (A).

British Columbia Section

Roy Douglas Jolly (A), A. W. Philips (A).

Buffalo Section

Philip S. Rogers (M).

Canadian Section

Horace Cook (A), H. R. Elstone (A), Donald A. MacLean (M), James H. MacMaster (J), Alexander H. McCuaig (A), Wilbur D. Prescott (A), Edgar Charles Row (M), Robert J. Twaddle (J).

Central Illinois Section

Kenneth R. Allen (J), Donald Edvin Cain (J), George P. Koch (J).

Chicago Section

John T. Arima (J), M. D. Burrows (M), Richard John Eisenach (J), James H. Graas (J), Robert O. Isenbarger (M), Robert D. Lamont (A), Francis P. Luzzo (A), George W. Morris (M), Milton C. Neul (J), Christ A. Oppegard (M), Jerry F. Pavelka (J), Earl B. Pridmore, Jr. (J), Loyd Pylat (J), Elmer H. Snyder (M), A. E. Weimann (A), Robert D. Wright (M).

Cincinnati Section

Philip H. Snoberger (J).

Cleveland Section

Reno P. Aguilano (J), Albert Edward Boffey (J), Harry M. Bramberry (M), Eugene P. Durack (A), Robert A. Edmonds (M), Cornelius Fiocco (J), Frank A. Flower (A), Richard W. Gent (M), Thomas A. Healy (M), William Manson Leavens (M), Michael Minich, Jr. (J), Ralph E. Mottin (J), William G. Patriquin (A), Karl A. Roesch (M), Russell Clarke Savage (A), Forrest E. Smith (M), Robert V. Snyder (M), Kenneth Joseph Sorace (M), Bernard A. Spon (J), John H. Waldorf (A), James Howard Walters (M), Russell S. Wetzel (M), Jerrold B. Winther (M), Carl E. Zowasky (M).

Dayton Section

William A. Frye (J), 2nd Lt. David G. Uitti (J).

Detroit Section

E. R. Anderson (A), Gerald F. Arnet (M), Garner T. Baldwin (M), Robert Baxter (A), Francis L. Bedard (J), Leo B. Bielecki (M), George Albert Bigham (J), Herman F. Borcherts (M), Donald Charles Bosker (J), Sanford Brown (J), Miles M. Brubaker (J), Jackson G. Byers (J), Robert F. Carlson (J), Robert Chapman, Jr. (J), John A. Cummings (M), Donald J. Deitrick (M), Moris D. Drake (J), Charles W. Duffy (A), James H. Fenner (J), Jack Andrew Fleming (M), W. I. Fowler (M), Coral W. Fries (A), James J. Glander (J), Charles F. Gruber (M), Herberth Edward Head (A), H. R. Holmes, Jr. (M), Andrew D. Hopkins (M), Ted Karmazin (J), Michael R. Krause (M), Elvin E. Lee (J), C. Robert Lomneth (M), Arthur Mader (M), Anthony O. Maloney (M),

Continued on Page 131

New Members Qualified
Continued

Gordon William McIntosh (J), Harry Iddings Miller, Jr. (A), Donald H. Mills (M), James B. Morcom (A), John Milne Murray, Jr. (J), Denis A. Nankivell (J), Edwin A. Nielsen (M), Nicolaus L. Plumer (J), Milan Pribich (J), Frank Chester Querry, Jr. (J), C. C. Raymond, Jr. (M), Walfred F. Riutta (M), Charles H. Romans (A), Thomas P. Saks (A), Arthur Schwartz (J), Frank William Sinks (J), Robert R. Swanberg (J), Charles W. Thomas (M), Edward M. Thomas, Jr. (A), Sumner B. Twiss (M), Robert William Whiteford (J), Percy C. Whiting (A), Raymond J. Wilcox (M).

Indiana Section

William L. Hudson (M), Jordan Phillip Jung (M), Ross Wilson McCormick (J), Donald G. Stong (J).

Kansas City Section

James A. Black (A), John W. Brooks (J), Hubert M. Fayman (A), Donald C. Hays (M), Robert James Hengel (A), William D. Hoener (A), Jay L. King, Jr. (M), Allen L. Newton (A), Arthur E. Patterson, Jr. (J), Lawrence Gene Scott (J), Charles A. Slater, Jr. (M), Daniel H. Smith (J), Ralph Irvon Spencer (M), Andrew J. Sutton (A), Robert G. Swift (M), John Edward Wolcott (J), H. D. Yantzi (J).

Metropolitan Section

Robert N. Bateman (M), Charles J. Bitzer (M), Donald Davidson (A), Robert E. Franseen (M), George E. Fink (M), Michael Fiorillo (M), Glenn Ray Hershey (J), Howard Holmes (M), Harold R. Holmyard (A), John Christopher Huebner (J), Irwin D. Miller (J), Richard E. Nenno (M), Raymond G. Newman (A), John Perry (M), James R. Summer (J), Kenneth R. Swartzfeger (A), L. H. Van Dyck (M), Ben Wanderman (M), J. C. Wright (A), Lewis H. Young (M).

Mid-Continent Section

Robert R. Kooiman (J), F. P. Tallman (A).

Mid-Michigan Section

Harold Frederick Carr, Jr. (J), Harry J. Scott (M).

Milwaukee Section

Richard J. Heil (M), Morris L. Hutchens (M), Lyle George Munson (J), Robert A. Parker (J), Andrew Wessel (J).

Continued on Page 132

New Members Qualified

Continued

Montreal Section

Jean Paul Boucher (A), Rodolphe Ernest Loiselle (A), Ernest Sidney Moore (M), Jean C. Paolucci (J), Lewis Kenneth Rutledge (M).

New England Section

Ellsworth G. Cameron (A), Daniel Paul Capriotti (A), William A. Martinez (A), Julius Rubin (A), Melvin J. Weiner (A).

Northern California Section

Albert R. Davidson, Jr. (J), Ensign Nathaniel Lewis Hawks (J), Harry W. Nevin, Jr. (M), Ernest O. Retherford (A), Carl William Rhodin (M), Roy Eugene Van Sickle (J).

Northwest Section

Sidney F. Cox (M), J. H. Foster (M), Charles Gillis (A), Milton B. Hammond, Jr. (J), Aivin H. Rand (J).

Philadelphia Section

Robert P. Clatterbuck (J), William S. Flogaus (J), George W. Francks (M), Oliver M. Hahn (M), Joseph Paul Kubik (A), Earl J. Pearce (J), James W. Savin (M), William J. Wear (A).

Pittsburgh Section

Charles D. Auria (A), M. George Breyer (M), John W. Hood (M), Richard L. Johnson (A), A. Nevin Jones (A), Monroe H. Kessler (M), Elgin Oehler (A).

St. Louis Section

A. J. Fuchs, Jr. (M), George K. Gilbert (A), Hbt. Rich Grumman (M), Stanley C. Harrington (A), Robert S. Lemen (M).

San Diego Section

John B. Hurt (M), Warner S. Lowe (J), Robert Gordon Sharp (M), Jerry B. Torrance (M), Wallace W. Withee (M).

Southern California Section

Elmer C. Anderson (J), Theodore R. Battema (J), John A. Best (J), Marshal S. Caley (M), Arthur M. Cole (A), Warren E. Douglas (A), Raymond C. Forsnas (M), Richard J. Hoard

Continued on Page 133

New Members Qualified

Continued

(M), Richard B. Huntington (J), Alfred J. King (A), Peter E. King (A), William S. Kozica (M), Gerald Clark Potvin (J), Barney Joseph Sheridan (J), Paul F. Smith (M), Roy E. Steinhoff (M), Horace W. Thue (M), Earl Edwin Vipond (J), Eugene W. Waterbury (J), William Marden Willis (M).

Southern New England Section

Hans J. Albrecht (M), Paul Errett Wolfe (M).

Spokane-Intermountain Section

George C. Fuller (A).

Syracuse Section

Robert T. Graulty (J).

Texas Section

James W. Amidei (A), Sam R. Billingsley (M), D. A. Brown (A), Joseph J. Ciesla (J), E. J. Clements (A), R. L. England (A), Roy V. High, Jr. (M), Walter E. Kolborn, Jr. (J), John W. Ludwig (M), L. L. Phillips (A), William Merrick Tisdale (J).

Twin City Section

Andrew Ambli (A), James A. Butcher (M), Duane C. Eckstedt (J), Robert Paul Lindeman (A).

Washington Section

Lynn L. Bradford (J), Charles J. Calvin (A), Laurence P. Mirick (A), Lt. Col. Anthony D. Nelson (M).

Western Michigan Section

Herbert H. Black (M), Ronald C. Groves (M), Charles W. Grubham (A), Charles T. Hardenburg (A), Richard C. Malott (J), Edward Orent (M), Elias W. Scheibe (M).

Williamsport Group

Kenneth R. Getz (J).

Outside of Section Territory

Carl Edwin Clark (J), Walter E. Davis (A), Marion R. Joy (M), Walter James Kearney (J), Ralph S. Mackey (J), Douglas F. Oliver (M).

Foreign

Cornelis Willem Stants (A), Holland.

Applications Received

The applications for membership received between March 10, 1953 and April 10, 1953 are listed below.

Atlanta Group

Robert E. Eason, Sr., Earl J. Tuttle, Jr.

Baltimore Section

Harry P. Kupiec.

Buffalo Section

John O. Archibald, Jr., Raymond Hartman, Donald Turrentine.

Canadian Section

Charles Ernest Comiskey, Ronald Patrick Davies, Wolfgang A. Kempff, Dennis Henry Milnes, John Greenwood Slaven, Louis Tereschuk, Leslie Arnold Thompson, William A. Trimble.

Central Illinois Section

Ralph J. Furstoss, T. H. Spencer.

Cincinnati Section

Clarence H. Slayton, Jr.

Chicago Section

William Strock Alexander, Harry Butcher, Jr., W. F. Collins, Earl L. English, Richard L. Fleshman, Edwin C. Juergens, Ray E. Kath, Richard E. Lyons, Henry B. Nelson, Jr., Emil L. Pesek, Jack B. Phelps, Paul T. Schultz, Frederick A. Shen, William P. Spencer, Joseph G. Stieber, Nils A. Thunstrom, Henry A. Weatherhead.

Cleveland Section

Earl T. Andrews, Carl Howard Bacon, Robert L. Christian, Charles B. Collins, Frank E. Dresner, William J. Gardner, Thomas D. Hogen, Marius J. Merlin, Edwin J. Murray, Frederick P. Salzman, Lewis R. Schilling, Robert Lewis Shaw, Russell L. Smith, Frank L. Snyder, Walter Everett Stewart.

Dayton Section

James E. Ballmer, Al Erhart, Leon Hall Fish, William A. Sponzilli.

Detroit Section

John Adams, Fred D. Barton, H. A. Berker, Ralph Frank Berlucchi, Charles Henry Boehm, Robert F. Busuttil, E. D. Caldwell, E. P. Carr, Carl Chakmakian, Girard N. Conti, Donald J. Curran, Edward D. Dall, Peter L. DeVries, Fred N. Eaton, William Benjamin Edmiston, Lothrop M. Forbush, Charles Vernon Frizzell, Carlo C. Fulco, John C. Guenther, Lawrence Joseph Heiser, Theodore R. Hoopes, Steve S. Hurite, Carl L. Kalitta, Joseph Kechis, Orville Paul Kesling, Floyd G. Lawrence, Henry J.

Continued on Page 136

Applications Received

Continued

Lefler, Anthony J. Leonard, Daniel Mathews, Edward H. McArdle, Jr., Wendell Lafayette Minor, Charles R. Mitchell, Joseph Mysza, Stanford Robert Ovshinsky, Paul S. Paulsen, Jr., Albert A. Pruchno, D. K. Rennie, Sydney W. Reseigh, Chester C. Sargent, Edward Metcalf Sawusch, Robert F. Shepherd, Samuel Taran, Jr., Patrick J. Valant, F. E. Tayler, W. H. Taylor, Harold Joseph Tuchyner, Richard George Waser, Arthur J. White, Thomas Gould Whittingham.

Hawaii Section

Roy Goya, Charles W. Hart, Robert R. Rex.

Indiana Section

Stephen Bruce Elrod, C. C. Hurlburt, Leonard B. Lisher, M. F. Trevey.

Kansas City Section

R. C. Hedglen, Eugene E. Strotheid.

Metropolitan Section

H. D. Alsdorf, Maurice Artaud, Thomas G. Barnes, Wallace E. Connolly, Charles C. Cozzens, Frank J. Dooney, Joseph T. Gushue, Malcolm McLoud, E. R. Noble, George F. Putnam, Paul V. Richards, Edward P. Sullivan, A. Stanley Thompson, Charles W. Yodzis.

Mid-Continent Section

Larry N. Lynch, William L. Welch.

Mid-Michigan Section

Gerald L. Hoddy, Garnet W. Martin, Russell C. Martz, David O. Smith.

Milwaukee Section

Robert H. Allen, Hugo F. Budzien, Gilbert H. Johnson, Clyde B. Sword.

Montreal Section

Arthur M. Gittins, William Dominic McCullough, Roland Plourde, John Tristram.

Mohawk-Hudson Group

Newell N. Davis, William R. Higgins, Ernest E. Johnson, Jr., Kenneth C. Spooner.

New England Section

Raymond Kenneth Andrew, Herbert P. Bagley, II, William B. Greeley, Charles Forsyth Hastie, Albert S. Kelley, Jr., Angelo F. Lucadamo, Jack R. Martin, Paul Polidoro, G. Eliot Saunders, Frank Edward Wahlen.

Northern California Section

Ray W. Daugherty, William B. Gripe, Donald R. Hackett, Elmer M. McLachlan, Edward H. Parkhurst,

Applications Received

Continued

Halbert R. Reed, Rogelio Sanchez.

Oregon Section

Harold G. Bogue, John L. Kruse.

Philadelphia Section

John R. Anderson, William T. Beaver, William G. Beyer, Morton Jacobson, John E. Mitchell, Lloyd W. Ream, Raymond Van Vechten, Benjamin Wayne Watson.

Pittsburgh Section

Charles Bello, Earl E. Bischof, Rankin J. Bush.

St. Louis Section

Charles J. Dinter, Jr., Clifford W. Sponsel.

San Diego Section

William T. Immenschuh, William E. Ragsdale, Joseph F. Schirtzinger, Melvin L. Williams.

Southern California Section

John Hawley Brooks, James A. Padden, Ivan J. Umbarger, R. A. Wagner, Eldon M. Wilson, Frank L. Wingo.

Southern New England Section

Donald Harris Amidon, John O. Emmerson, Donald H. Merry, James A. Taylor.

Spokane-Intermountain Section

Lytle Richard Van Dusen.

Syracuse Section

Blair McClenachan, Richard E. Posthauer.

Texas Section

Howard R. Carlson, Ben F. Denny, Walter Gladson, B. E. Gray, Clifford F. Holcombe, Charles D. Kemp, Lee L. Rorex, J. C. Tatum.

Twin City Section

Robert C. Butler, Gilbert Carl Sitz, Lester A. Wilsey, Jr.

Washington Section

Allen Soong Yaplee.

Western Michigan Section

Armen V. Babayan, George A Spoon, Albert E. Whitney, Jr.

Williamsport Group

Robert W. Edwards.

Outside of Section Territory

Norman James Carlson, William James Esdale, Kingsley E. Humbert, Jr., Melvin Maurice Moncel, David Alison Shuler.

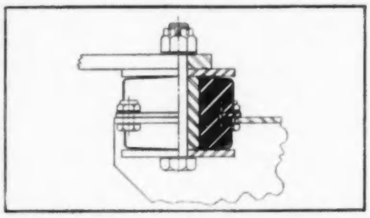
Foreign

Hermann Bertram, Germany; Jogendra Singh Manku, India; Harry Wilson, England.

Advertisement

Railroad Equipment Protected By Lord Mountings

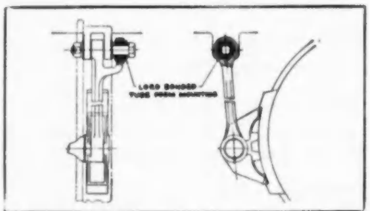
A special plate form mounting has been designed by Lord Engineers for use as a shock mounting for engine-generator and motor-compressor units installed on railroad rolling stock. The problem was to design a Lord Mounting which would minimize the shocks of coupling and uncoupling cars and thus prevent damaging the undercar equipment referred to above.



An existing Lord plate form mounting design was utilized with a steel tubing insert in the elastomer to increase the stiffness of the mounting. Tooling and research expense were thus saved by this unusual application of Lord Mountings previously designed to solve another similar problem.

Excessive Wear Eliminated By Use of Lord Mountings

A recently designed Lord Mounting has solved a problem for a manufacturer of brake assemblies in the railroad field. A Lord Tube Form Mounting design was utilized as a joint for the brake hanger mechanism. Through the use of rubber bonded to metal sufficient motion was permitted to compensate for shock while eliminating wear on the pin and joint at the point of motion.

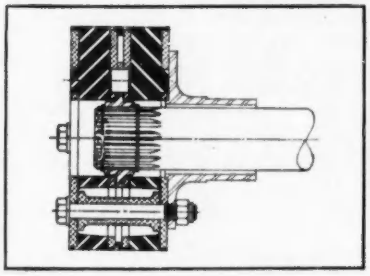


Lord Engineers determined the amount of resiliency required to effect a firm joint while permitting sufficient movement to eliminate excessive wear. An existing design was used with the correct elastomeric compound to meet the necessary requirements. Thus a considerable saving was achieved.

Advertisement

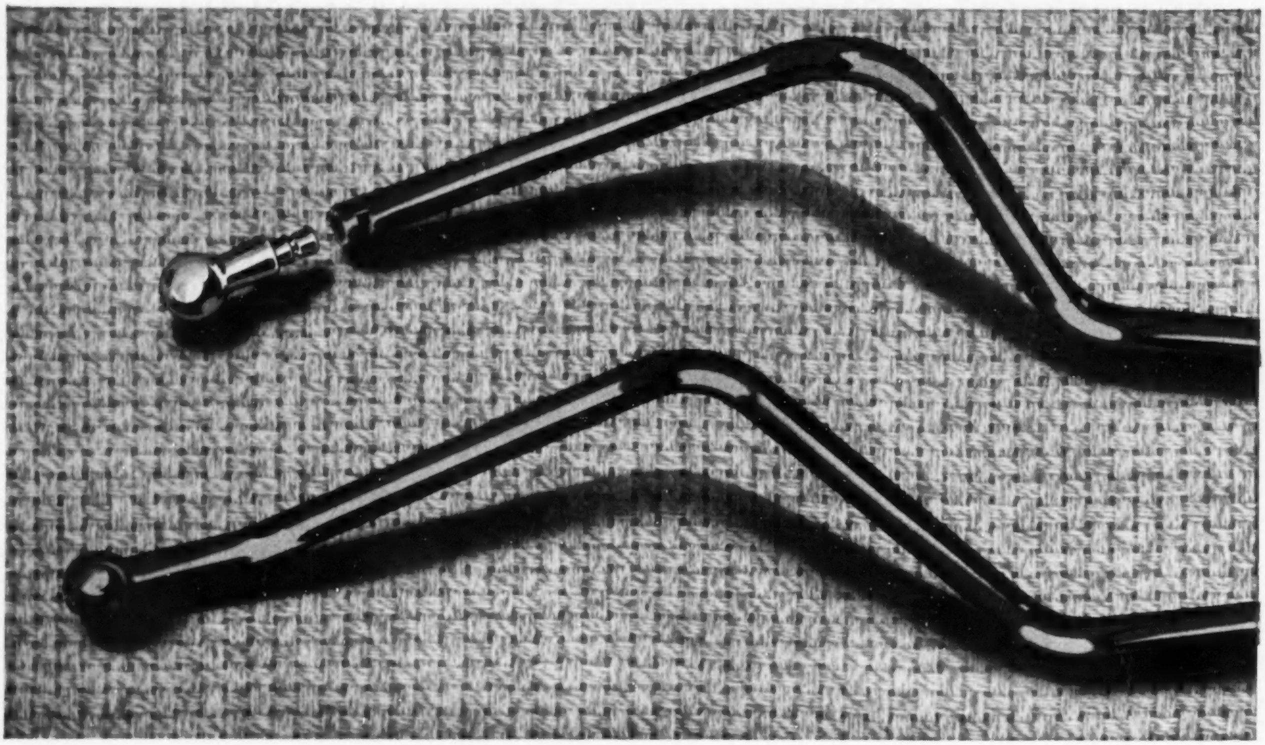
Lord Flexible Coupling Flies With Kaman Helicopter

The Kaman K-5 helicopter presents an interesting application of the LORD J-5329-2 flexible coupling with the Boeing 502-2 gas turbine. The function of the coupling in this case is to absorb the torsional vibrations of the system and isolate the turbine from the rotors. However, the unit also serves to accommodate angular or parallel misalignments due to manufacturing tolerances or dynamic motions.

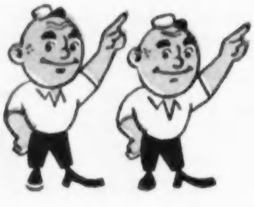


The unique design of the installation provides maximum accessibility and economical maintenance through the use of concentric driving and driven shafts. The inner member of this pair is the engine shaft which drives the coupling hub through a splined connection. Precompressed against the splined hub are the two bonded rubber coupling halves which transmit the engine torque in shear of the rubber. Four through-bolts connect the outer plates of the coupling halves to the driven hub and also serve as the safety interlock in case the rubber sections are destroyed. The first gear of the transmission is mounted on this driven hub and feeds power on through the system in to the helicopter rotors.

For over thirty years the Lord organization has specialized in designing and producing Bonded Rubber Flexible Couplings, Vibration and Shock Control Mountings and Component Parts. The capabilities of Lord Engineering have proved their worth to designers of industrial and automotive equipment in many diversified fields as is indicated in this instance.



Three-piece accelerator rod simplified to one piece of Bundyweld Tubing



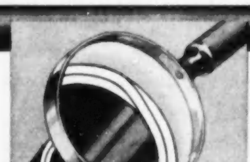
WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of copper-coated steel. Then it's . . .

continuously rolled twice around laterally into a tube of uniform thickness, and

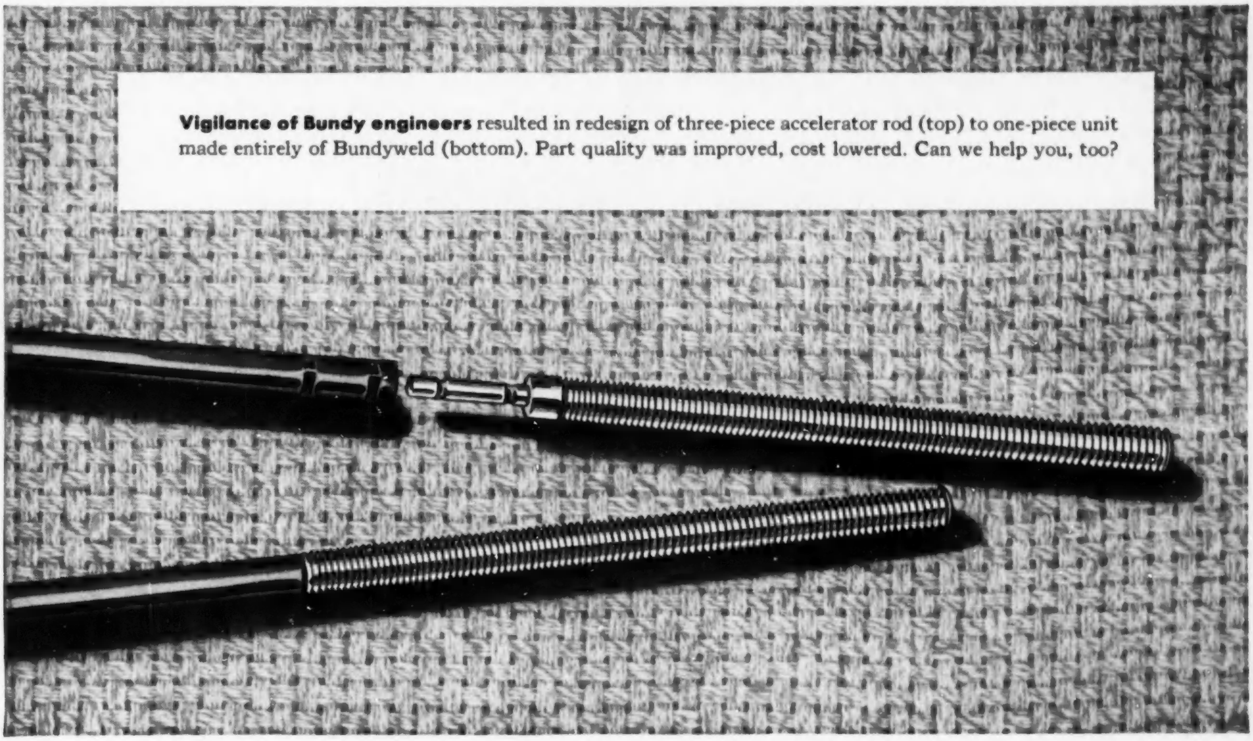
passed through a furnace. Copper coating fuses with steel. Result . . .

Bundyweld, double-walled and brazed through 360° of wall contact.



← **NOTE** the exclusive patented Bundyweld beveled edges, which afford a smoother joint, absence of bead and less chance for any leakage.

Bundy Tubing Distributors and Representatives: ***Cambridge 42, Mass.:*** Austin-Hastings Co., Inc., 226 Binney St. • ***Chattanooga 2, Tenn.:*** Peirson-Deakins Co., 823-824 Chattanooga Bank Bldg. • ***Chicago 32, Ill.:*** Lapham-Hickey Co., 3333 47th Place • ***Elizabeth, New Jersey:*** A. B. Murray Co., Inc., Post Office Box 476 • ***Philadelphia 3, Penn.:*** Rutan & Co., 1717 Sansom St. • ***San Francisco 10, Calif.:*** Pacific Metals Co., Ltd., 3100 19th St. • ***Seattle 4, Wash.:*** Eagle Metals Co., 4755 First Ave., South ***Toronto 5, Ontario, Canada:*** Alloy Metal Sales, Ltd., 181 Fleet St., East • **Bundyweld nickel and Monel tubing is sold by distributors of nickel and nickel alloys in principal cities.**



Vigilance of Bundy engineers resulted in redesign of three-piece accelerator rod (top) to one-piece unit made entirely of Bundyweld (bottom). Part quality was improved, cost lowered. Can we help you, too?

A Bundy customer's accelerator-rod design called for a threaded rod and a ball-end to be mechanically held in opposite ends of a piece of formed ¼″ O.D. Bundyweld Tubing.

While we produced the rod according to specifications, our engineers took a good hard look at the part. They soon came up with a simple, sound idea to produce a stronger, more durable part at less cost to our customer.

You see the result above—a one-piece accelerator rod of Bundyweld Tubing threaded on one end, expanded and formed into a ball at the other. Perhaps you can see several factors that will work to *your* advantage, too.

Take Bundyweld itself, for instance. It's the automotive industry's standard of dependability. It's the only tubing double-walled from a single strip, copper-bonded throughout 360° of wall contact. It has high tensile strength, high yield strength, high fatigue limit. And, of course, there's almost nothing that it won't take in the way of fabrication beating.

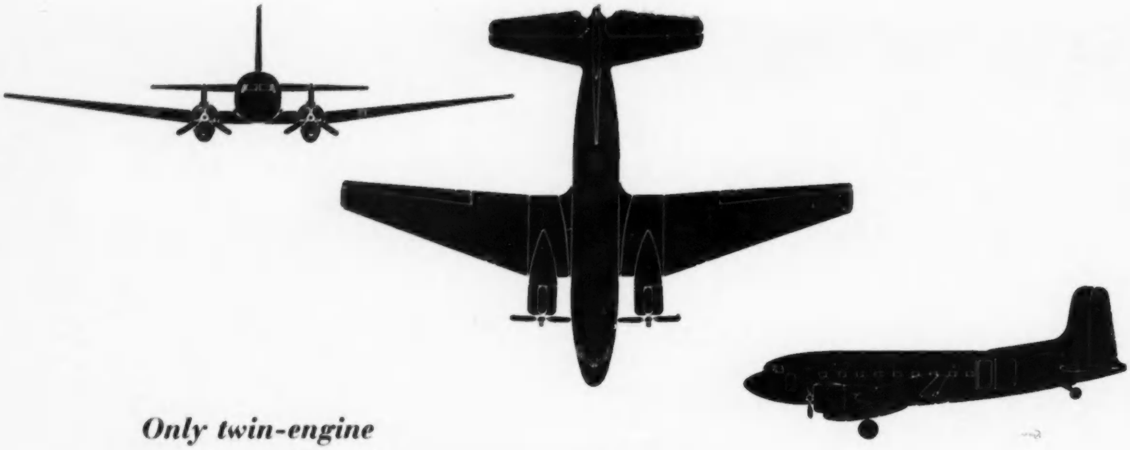
When you hand us the design for a tubing part, we're geared to produce it in volume to your specifications—thanks to Bundyweld and thanks to our skilled men and Bundy-developed bending machines. But if we can suggest a cheaper way of making the part or a way of improving it, or both, we'll speak up. It's our policy to do so. If you're set up to handle your own fabrication operations, however, we'll be glad to ship you clean straight lengths of Bundyweld.

For an Improved, lower-cost accelerator rod—or for that matter, for leakproof brake, gasoline, and oil lines, talk things over with a Bundy tubing specialist. Call, write, or wire Bundy Tubing Company, world's largest producer of small-diameter tubing.

BUNDY TUBING COMPANY • DETROIT 14, MICHIGAN

Bundyweld Tubing®

DOUBLE-WALLED FROM A SINGLE STRIP



Only twin-engine

transport that makes regular flights

to Hawaii, the Navy's

Douglas R4D-8

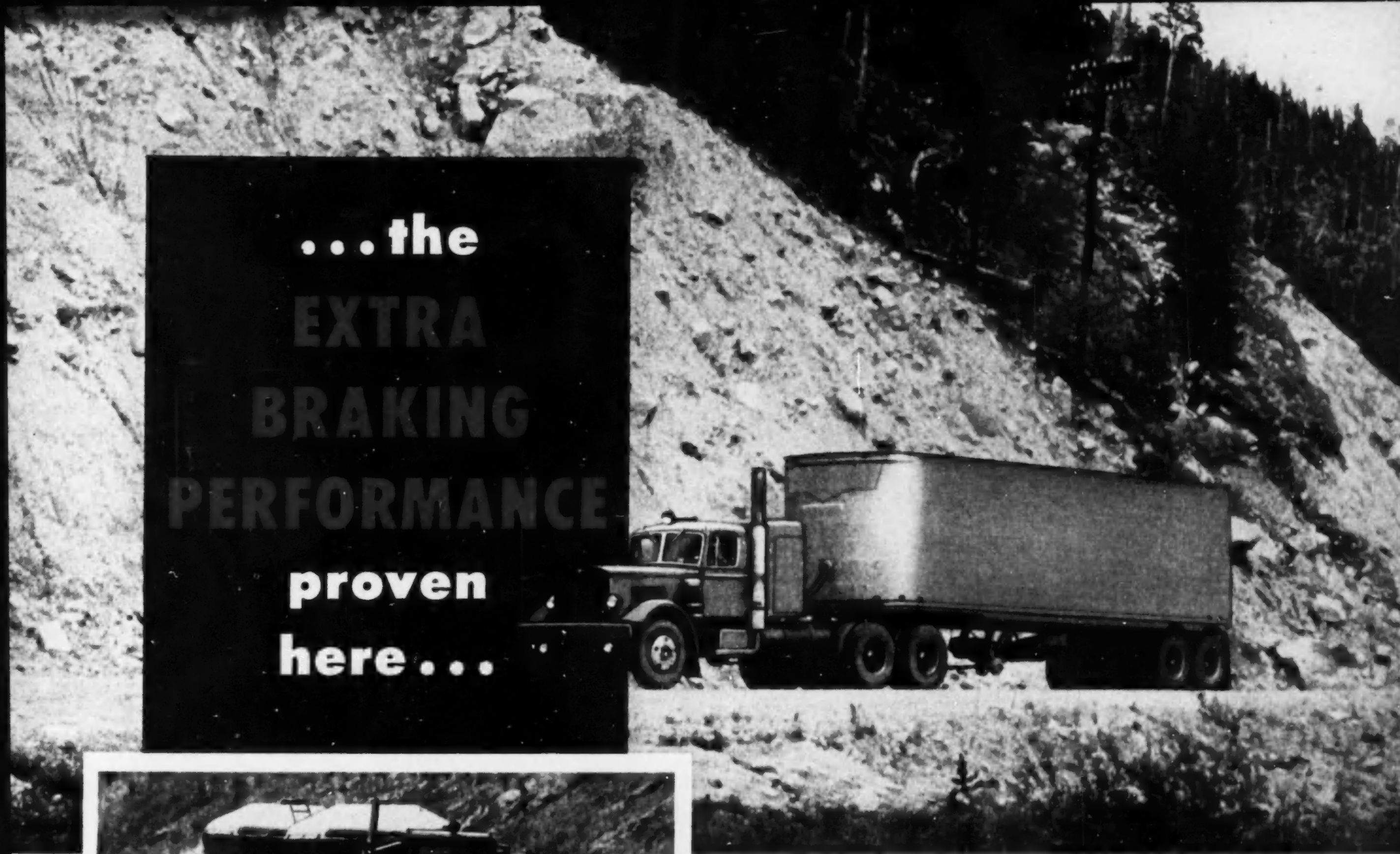
Unique among twin-engine aircraft is the Navy's Douglas R4D-8. On orders, this transport can take off at San Francisco and safely wing its way across 2,562 miles of open Pacific to Hawaii.

Born of the Douglas DC-3, world's best known airplane, R4D-8 is longer, more powerful and flies on new swept wings. It carries 2,800 more pounds of payload 45 m.p.h. faster than its famous parent. Ceiling and range are greater. Passenger and freight loading are easier, quicker. And along with its improved performance, the Douglas R4D-8 still combines DC-3 reliability with twin-engine economy.

Development of the R4D-8 is another example of Douglas leadership in aviation. Planes that can be produced in quantity to fly *faster and farther with a bigger payload* are a basic Douglas rule.

Enlist to fly with the U.S. Navy

Depend on *DOUGLAS* First in Aviation



...means SAFER, SURER STOPS on any hauling job!

Smooth, Sure-Acting Bendix-Westinghouse Air Brakes Step-up Schedules, Safety and Profits on Rugged Runs!

How would you like to help your truck customers shorten trip schedule time? Step up driver efficiency? Increase their margin of profits? Obviously, you would . . . *and you can* by simply taking a tip from the men who operate the big rigs over the rugged Rocky Mountains. Here, **under the toughest, most demanding conditions, fleet records show Bendix-Westinghouse Air Brakes help answer** all three questions. That's because these mighty brakes deliver the extra stopping power and performance that assure maximum control—anywhere, any time. As a result, **unnecessary slowdowns are eliminated because drivers know they can stop.** Thus, trip speeds can be increased, heavier payloads carried safely. In addition, Bendix-Westinghouse Air Brakes require less maintenance—overhead comes down because **trucks stay on the job instead of piling up expense in the shop.** So just add up all the advantages. No matter what type trucks you manufacture, give your customers the benefits of added performance and profits by specifying Bendix-Westinghouse, the world's most tried and trusted air brakes!

Bendix-Westinghouse

THE WORLD'S MOST TRIED AND TRUSTED

AIR BRAKES

BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE COMPANY • ELYRIA, OHIO • BERKELEY, CALIF.

CONVAIR 340
This picture of the Convair 340 shows what Rohr is famous for — building power packages — power packages for the Convair 340 — and other world-famous commercial and military planes. Of course, Rohr aircraftsmen do more than this. Currently they are producing more than 25,000 different parts for all types of airplanes.
power packages by
ROHR
WORLD'S LARGEST PRODUCER
OF READY-TO-INSTALL POWER PACKAGES FOR AIRPLANES
ROHR
AIRCRAFT CORPORATION
CHULA VISTA AND RIVERSIDE CALIFORNIA

"U. S." Research perfects it . . .

"U. S." Production builds it

In the great laboratory in the United States Rubber Company plant at Fort Wayne, scientists and engineers are working on problems involving rubber-to-metal parts and plastic parts for the automotive industry. They have at their command one of the most modern and extensive laboratories in existence – equipped with all the latest research and development facilities. "U. S." RESEARCH PERFECTS IT.

And then in the great Fort Wayne plant itself, ideally located for "on-the-doorstep" service to the automotive industry, skilled men produce the rubber-to-metal parts and precision molded rubber and plastic parts, and precision extrusions that make equipment last longer, ride more comfortably, more economically.

"U. S." sales engineers are right on your doorstep—at New Center Bldg., 7430 Second Ave., Detroit 2. They are your contact with the Fort Wayne laboratory and plant. And remember, the "U. S." experts have solved many and many a problem when all others had given up. For full information, write to address below.

U.S.RUBBER
SERVING THROUGH SCIENCE

"U. S." Research perfects it
"U. S." Production builds it

UNITED STATES RUBBER COMPANY

Automotive Sales, Mechanical Goods Division, New Center Bldg., Detroit 2, Michigan

No wonder your shop squawks, these days, about every job that calls for skilled operators:

"Where'll I get the OPERATORS for 12 reams per unit?"

What can **you** do about it—**without** sacrificing product quality? Well, you can

specify

"COMPO"® and "POWDIRON"® bearings

(porous bronze) (sintered iron)

They need no reaming! A simple press fit sizes them to accurate as-installed I.D. Most of the time, they do away with the need for oil holes and fittings. That cuts out drilling and tapping operations.

Tell **Production** how these bearings speed up output.

Tell **Management** how they reduce costs.

Tell **Sales** how long they last, with little or no attention.

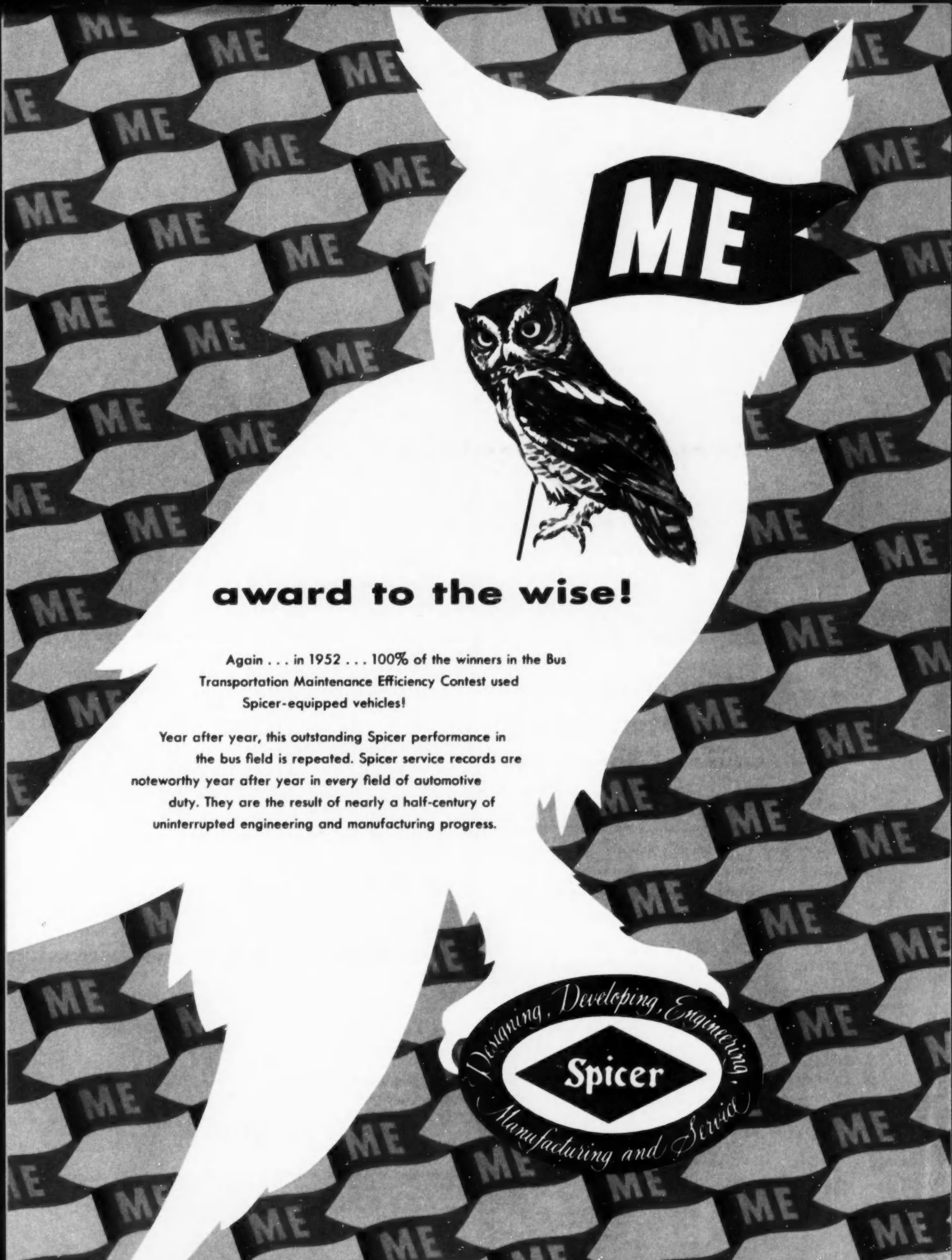
You'll find all the facts you need on these oil-retaining bearings—products of Bound Brook powder metallury—in our bulletins on advantages, application, installation, sizes. Just write for your copies.

"COMPO" • "POWDIRON" • "BOUND BROOK" •

Buy Bound Brook

BOUND BROOK
OIL-LESS BEARING COMPANY

Bound Brook, N. J. **Bound Brook 9-0441**
MANUFACTURERS OF BEARINGS AND PARTS • ESTABLISHED 1883


ME
award to the wise!
Again . . . in 1952 . . . 100% of the winners in the Bus Transportation Maintenance Efficiency Contest used Spicer-equipped vehicles!
Year after year, this outstanding Spicer performance in the bus field is repeated. Spicer service records are noteworthy year after year in every field of automotive duty. They are the result of nearly a half-century of uninterrupted engineering and manufacturing progress.
Designing, Developing, Engineering, Manufacturing and Service
Spicer


Billions of people moved faster, easier because of Spicer
Spicer furnishes high-precision equipment for practically every power-transmission need in automobiles, buses, trucks, tractors and other civil and military vehicles. With its ten modern production plants . . . and its skilled personnel in every department . . . Spicer can serve you fully, completely, dependably.
49 YEARS OF
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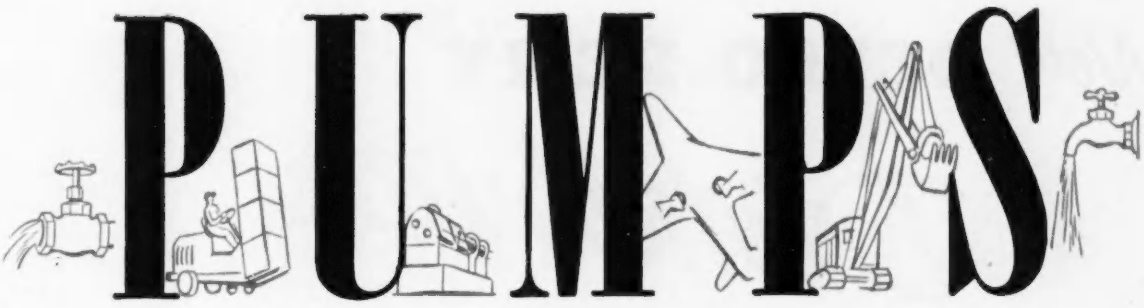
TRANSMISSIONS • UNIVERSAL JOINTS • BROWN-LIPE AND AUBURN CLUTCHES • FORGINGS • PASSENGER CAR AXLES • STAMPINGS • SPICER "BROWN-LIPE" GEAR BOXES • PARISH FRAMES • TORQUE CONVERTERS • POWER TAKE-OFFS • POWER TAKE-OFF JOINTS • RAIL CAR DRIVES • RAILWAY GENERATOR DRIVES • WELDED TUBING

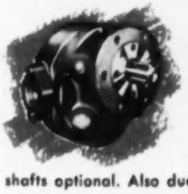


PUMPS

for HomE, DefensE + Industry!

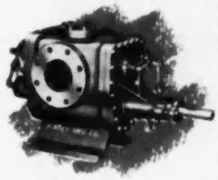
What do you need . . . Hydraulic controls for a bomber, a helicopter, a guided missile or for a machine tool, piece of construction equipment, lift truck or paper machine? A better water supply for your home or pumps for an entire irrigation project? Or, perhaps, you need high vacuum pumping facilities or a pump that will handle paraffin, tar or syrup. Whatever it may be, you'll find pretty close to an ideal answer here . . .

HYDRECO GEAR TYPE PUMPS



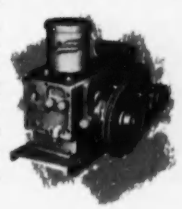
Reversible and non-reversible. Gear type pumps in exclusive FOUR-BOLT design . . . capacities from .5 to 130 gpm and operating pressures to 1500 psi . . . flange or foot mounted . . . furnished with keyed shaft with spline shafts optional. Also dual and tandem models.

KINNEY LIQUID HANDLING PUMPS



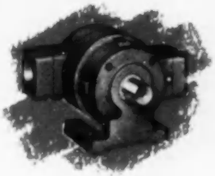
A complete range of sizes in Rotating Plunger and Herringbone Gear Pumps to handle light or heavy liquids, sludges, slurries or viscous substances. Available in plain or steam jacketed models and built of special corrosion resistant metals where desired.

KINNEY VACUUM PUMPS



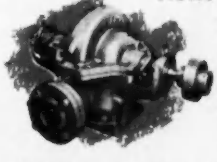
Single stage models to produce absolute pressure readings of 10 microns (.01 mm Hg.) . . . compound pumps producing readings of .2 microns (.0002 mm Hg.) or better. These Kinney High Vacuum Pumps are available in sizes for laboratory as well as high production use.

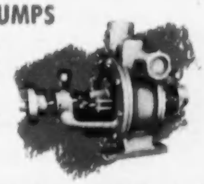
DUDCO DUAL VANE TYPE PUMPS



DUDCO Pumps provide a broad range of sizes with capacities to 120 gpm and pressures to 2000 psi. Also available in multiple units operating from a single drive. Hydraulic motors with starting torque outputs to 14,000 lb. in. at 2000 psi.

AURORA CENTRIFUGAL & TURBINE PUMPS



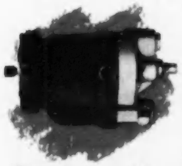


Deep well, sump, drainage and condensation return units, household water systems. Industrial low and high pressure liquid handling pumps. Direct motor and countershaft driven horizontal and vertical models. Capacities 3 to 7500 gpm.

THE NEW YORK AIR BRAKE COMPANY

230 PARK AVENUE • NEW YORK 17, N.Y.

STRATOPOWER PISTON TYPE PUMPS



Axial reciprocating piston type . . . constant or variable delivery with capacities of .25 to 10 gpm at nominal speeds of 1500 rpm with maximum of 4500 rpm . . . working pressures to 3000 psi . . . direct engine and individual electric motor driven models.

Write—

For detailed information on the type of pump in which you are interested.

THE NEW YORK AIR BRAKE COMPANY
230 Park Avenue., Dept. SAE, New York 17, N. Y.

Gentlemen: Kindly send additional information on the pumps I have checked.

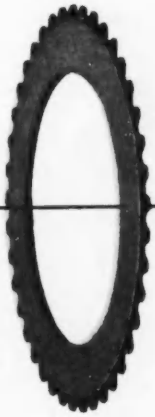
- ☐ Hydreco Pumps
- ☐ Stratopower Pumps
- ☐ Dudco Pumps
- ☐ Kinney Liquid Handling Pumps
- ☐ Kinney Vacuum Pumps
- ☐ Aurora Pumps

Name ....

Address ....

City .... State ....

Moraine Friction Materials

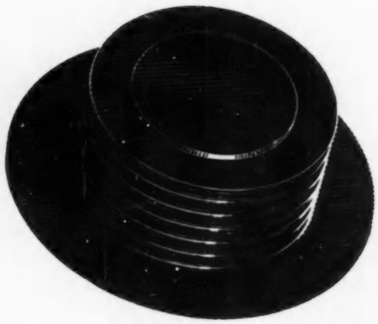


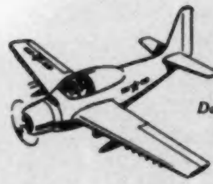
Moraine friction materials have a number of characteristics that make them highly useful to many industries. For example, by dispersing non-metallic materials uniformly through a semi-metallic or metallic matrix, the ultimate materials develop great resistance to wear and remain stable over a wide range of temperatures. In many cases the materials are bonded to a steel support which provides additional strength and increases the range of their application.

Moraine friction materials have proved themselves in automatic transmissions such as Powerglide, Dynaflow and Hydra-Matic. They are equally successful in special military vehicles and equipment, household appliances, and automatic transmissions for trucks of all sizes.

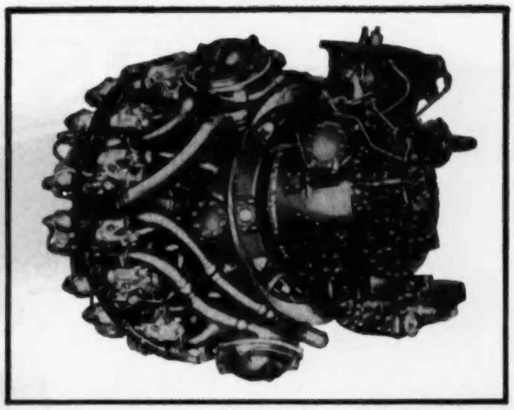
moraine products

DIVISION OF GENERAL MOTORS CORPORATION, DAYTON, OHIO

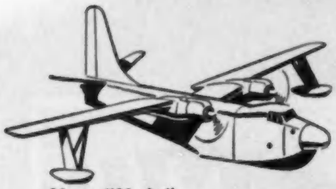




Douglas "Skyraider"



Wright Turbo Compound Aircraft Engine



Martin "Marlin"

Lockheed "Super Constellation"

OSBORN

BEFORE: Closeup of helical gear before deburring.

Gone . . . costly thorns in their side

Burr removal by muscle methods is aggravating because it is costly, inefficient and non-uniform in quality. Here's how a truck manufacturer has banished these "thorns in the side" with push-button brushing.

The operation: to deburr, break and blend the flank edges of gear teeth prior to shaving and heat treating. Formerly done with a hand tool, in several operations, the work was tedious and required close inspection and reworking to meet rigid specifications.

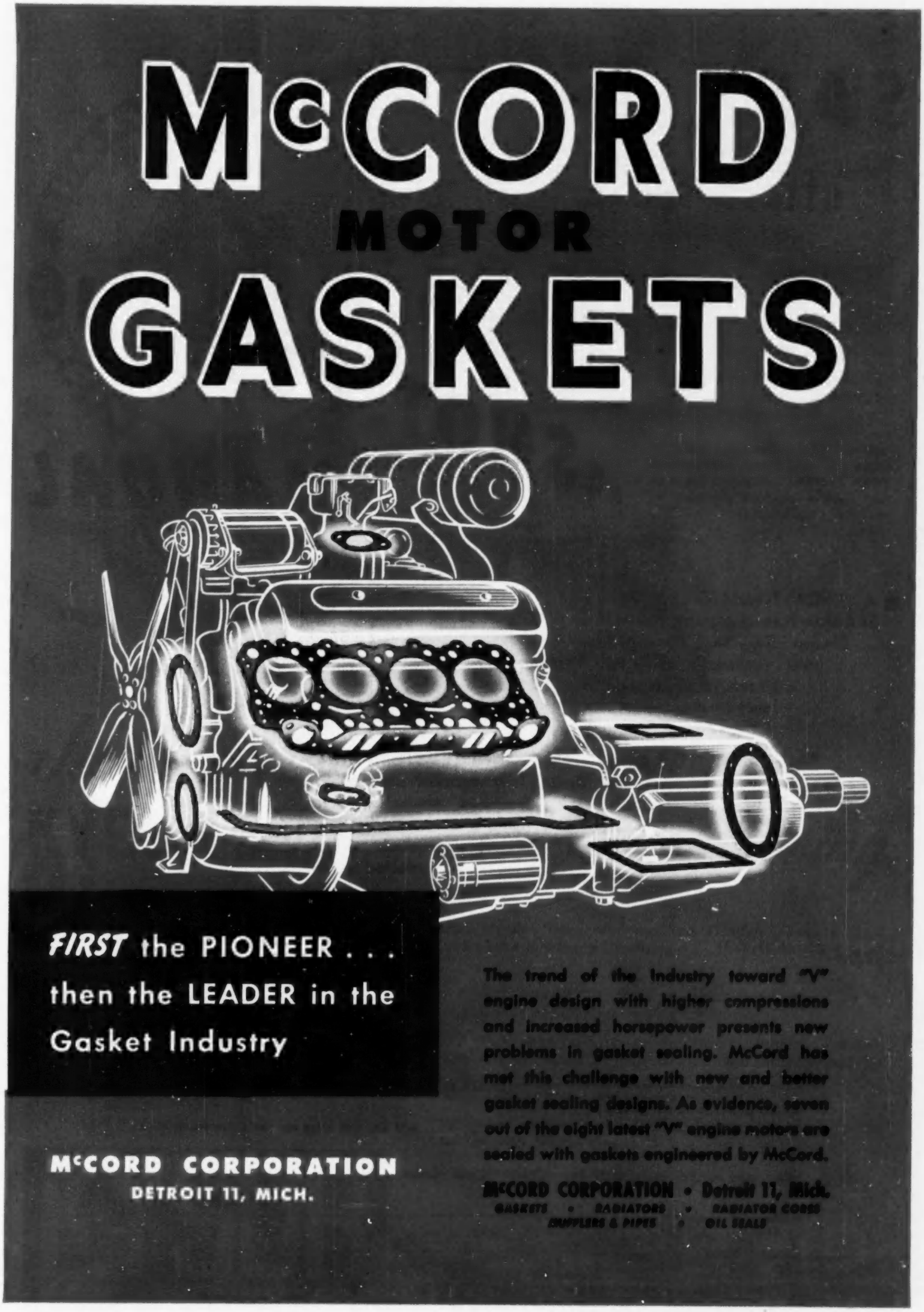
Now, an Osborn Brushing Machine in one speedy operation smooths the entire tooth edge . . . produces ***uniform blending*** of surface junctures of ***every tooth***. Result: lower costs and greater precision for ***better performance*** of the product in service.

Find out how ***you*** can cut your costs and improve ***your*** products with power brushing. Call the nearby **O**sborn **B**rushing **A**nalyst or write *The Osborn Manufacturing Company, Dept. S-3, 5401 Hamilton Avenue, Cleveland 14, Ohio.*

AFTER deburring with Osborn Brushing Machine.

Osborn Brushes

OSBORN POWER, MAINTENANCE AND PAINT BRUSHES AND FOUNDRY MOLDING MACHINES


McCORD
MOTOR
GASKETS
FIRST the PIONEER . . .
then the LEADER in the
Gasket Industry
McCORD CORPORATION
DETROIT 11, MICH.
The trend of the Industry toward "V" engine design with higher compressions and increased horsepower presents new problems in gasket sealing. McCord has met this challenge with new and better gasket sealing designs. As evidence, seven out of the eight latest "V" engine motors are sealed with gaskets engineered by McCord.
McCORD CORPORATION • Detroit 11, Mich.
GASKETS • RADIATORS • RADIATOR CORES
MUFFLERS & PIPES • OIL SEALS

KYSOR's "up front" on these giant Euclids on the world-famed Iron Range . . . teamed with Euclid engineering to keep these monsters fighting fit the year 'round.

KYSOR sees plenty of Pacific Northwest scenery from the nose of these Peterbilt tractors in 2200 mile weekly hauls for famous Tea Garden Foods of San Leandro, California.

Jams 'n Jellies or Iron Ore...
KYSOR *delivers All-Season savings!*

Whether it's Peterbilt tractors toting delicious Tea Garden jellies or giant Euclids sweating it out on the Minnesota Iron Range . . . MAINTENANCE COSTS ARE VITAL!

That's why there's KYSOR shutters "up front" to keep these power plants operating 'round the calendar at perfect operating temperature.

In Death Valley heat or Alaskan cold . . . on the 4th of July or on Lincoln's birthday, KYSOR delivers *all-season* savings on fuel and maintenance by holding operating temperatures within that magic 8° range. Result: Longer engine life, fewer major overhauls and fuel savings up to 12%.

Wherever engines work—KYSOR does a savings job! Write for complete information.

KYSOR

Automatic **SHUTTERS**

"Wherever Engines Work"

KYSOR HEATER COMPANY - CADILLAC, MICH.

L·O·F Fiber·Glass mutes H-F engine sound to a murmur*

Passengers thrill to the speed and power of modern cars, *and* enjoy quiet, comfortable interiors . . . made possible by the excellent sound reduction properties of L·O·F Super·Fine Fiber Glass installed throughout the car.

Outstanding thermal and sound-insulating properties of L·O·F Super·Fine Fiber·Glass make it ideal for use throughout the car. It is used for roof liners, on fire walls, under package trays and as dash liners. And the L·O·F Hoodliner installed under the hood reduces air-borne noise.

L·O·F Fiber·Glass is lightweight, flexible and easy to install. The fine glass fibers will not rot, burn or absorb moisture. Libbey·Owens·Ford's long experience in glassmaking assures you of top-quality Super·Fine Fiber·Glass supplied to meet your schedules *right on time.*

For more information, call L·O·F's Detroit office, 610 Fisher Building, Trinity 5-0080. Or write Libbey · Owens · Ford Glass Company, Fiber · Glass Division, 653 Wayne Building, Toledo 3, Ohio. Names of suppliers of Hoodliner Kits sent upon request.

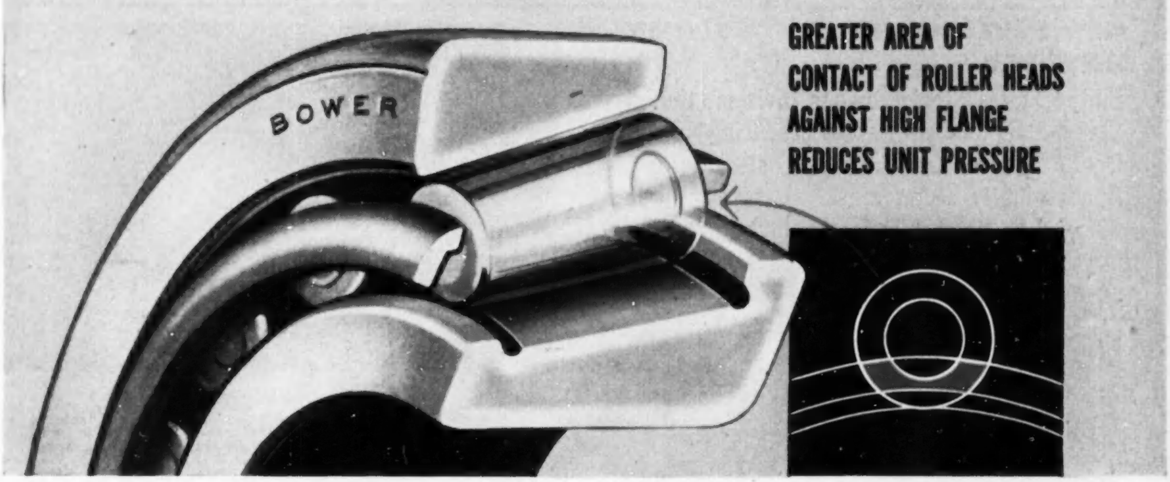
* *High Frequency.*

LOF GLASS · LOF PLASKON · LOF FIBER-GLASS

LIBBEY·OWENS·FORD GLASS COMPANY
FIBER-GLASS DIVISION

FIBER·GLASS

Bower spher-o-honed design increases bearing life



Bower engineers have incorporated many basic refinements into the design of Bower tapered roller bearings which cut maintenance to a bare minimum—increase efficiency. One of the most important of these is the *exclusive* feature illustrated above. Note that the flange at the large end of the cone is *higher*—providing a greater contact area for the roller heads. This greatly reduces wear, improves roller alignment and minimizes resultant "end play". Also note the larger oil groove, providing positive lubrication to the roller heads.

Other important Bower features which increase bearing life and dependability are generated spherical roll-heads, and smooth, precision-honed races. And Bower bearings are known throughout industry for materials and workmanship of highest quality.

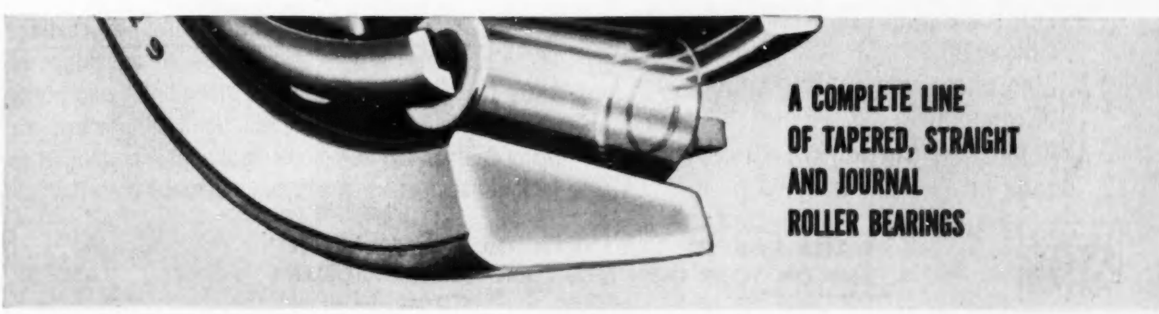
Whether your product is in full production or still in the planning stage, you'll be wise to call in a Bower engineer now. He'll show you a wide range of sizes and types to fit any application.

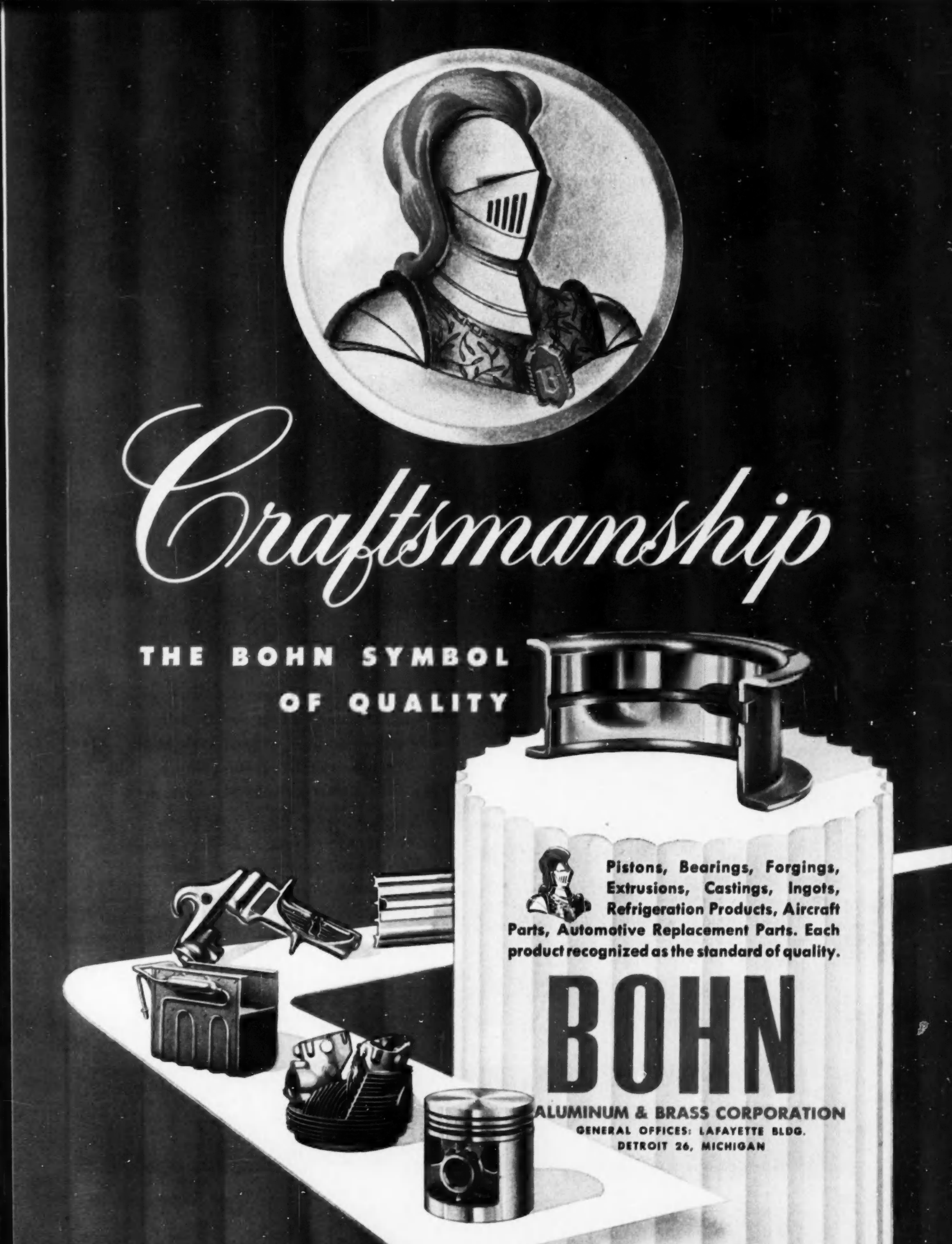
BOWER ROLLER BEARING COMPANY • DETROIT 14, MICHIGAN

BOWER

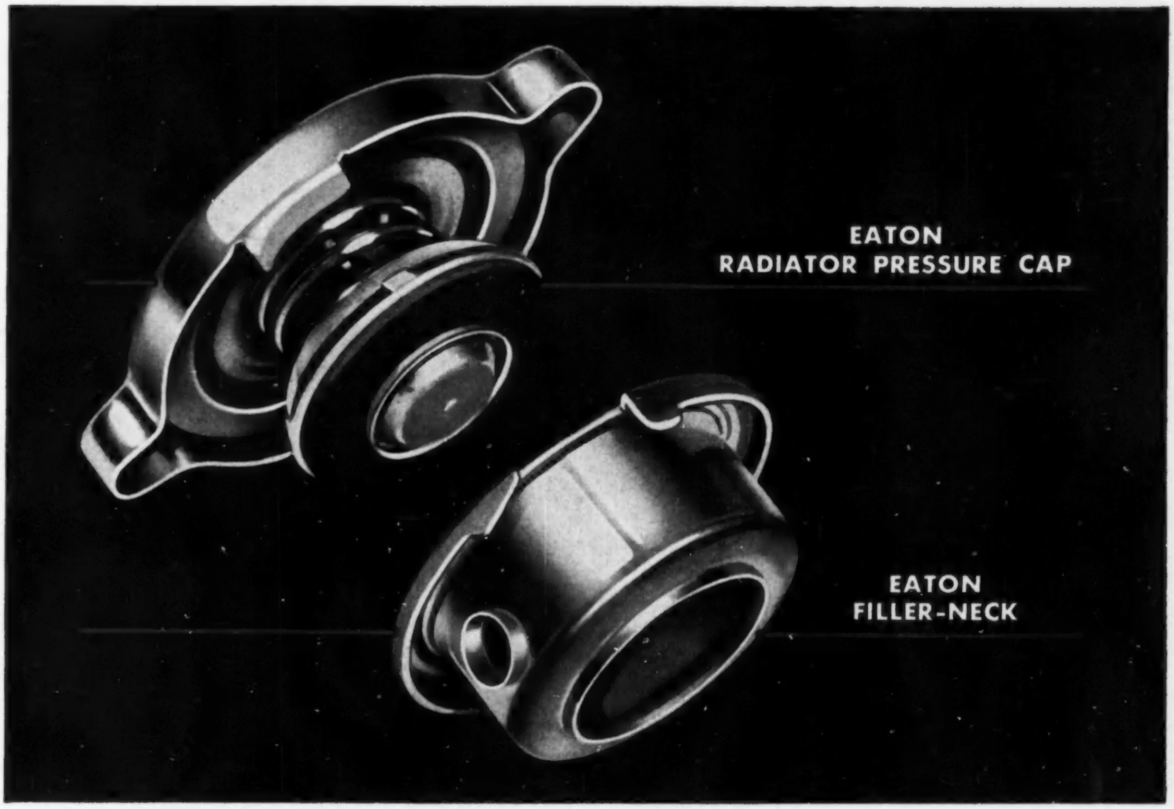
ROLLER BEARINGS

SPHER-O-HONED




Craftsmanship
THE BOHN SYMBOL OF QUALITY
Pistons, Bearings, Forgings, Extrusions, Castings, Ingots, Refrigeration Products, Aircraft Parts, Automotive Replacement Parts. Each product recognized as the standard of quality.
BOHN
ALUMINUM & BRASS CORPORATION
GENERAL OFFICES: LAFAYETTE BLDG.
DETROIT 26, MICHIGAN


The SOFT Acting Clutch
with the SURE GRIP!
. . . just like a
Hand of Steel
in a
Velvet Glove
LIPE
MULTI-LEVER
CLUTCH
Lipe's soft-engagement, positive-grip Multi-Lever Clutch never needs babying. It engages smoothly—without grab, shock or jerk. All parts of the pressure plate touch at the *same instant* with the *same* pressure. There's no cocking—no point of high slippage and spot burning.
Result: *More mileage between tear-downs.*
The hand of steel in the Lipe Clutch has 20 fingers that equalize the pressure of a single spring—assuring softer engagement and positive grip.
Write for Service Manual and complete data on genuine Lipe parts—stocked in principal cities.
LIPE ROLLWAY
Lipe-ROLLWAY CORPORATION
Manufacturers of Automotive Clutches and Machine Tools
Syracuse 1, N. Y.



This Pair Makes Engines Run Better

By sealing the cooling system and raising the boiling point of the coolant, the Eaton pressure relief cap permits engines to operate in a more efficient and more economical temperature range without boiling away water or anti-freeze; provides for smoother engine performance, better lubrication, quicker warm-up, improved heater operation. In heavy-duty service, at high altitudes, or in extremely warm climates, this is an important safeguard against possible engine damage due to loss of coolant through evaporation. It also prevents loss of coolant due to surge.

With a sealed cooling system vehicles can be designed with smaller radiators at considerable saving in cost.

Eaton offers the advantage of a single source of supply for pressure cap and filler-neck requirements; eliminates divided responsibility; assures positive mating of cap and neck; saves engineering and purchasing contact time. Eaton engineers will welcome an opportunity to work with you in developing the most efficient and economical closure—standard or pressure type—for your cooling systems.

EATON MANUFACTURING COMPANY

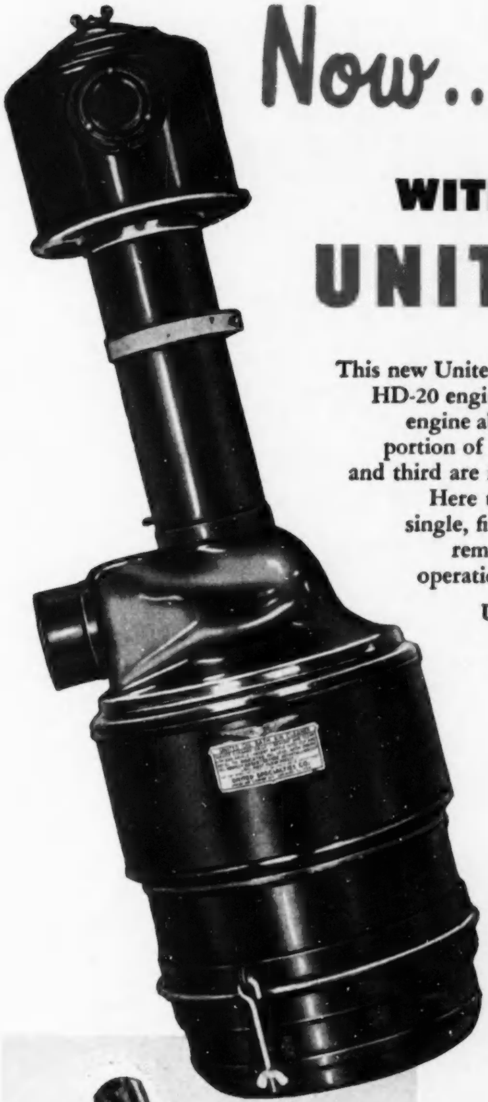
CLEVELAND, OHIO

STAMPING DIVISION: Detroit Office, 18001 James Couzens Highway, Detroit 35, Michigan

ORIGINATORS OF THE BAYONET-TYPE CAP AND FILLER-NECK FOR PRESSURIZED COOLING SYSTEMS

Now... Triple Protection

WITH NEW HEAVY-DUTY UNITED Air Cleaner

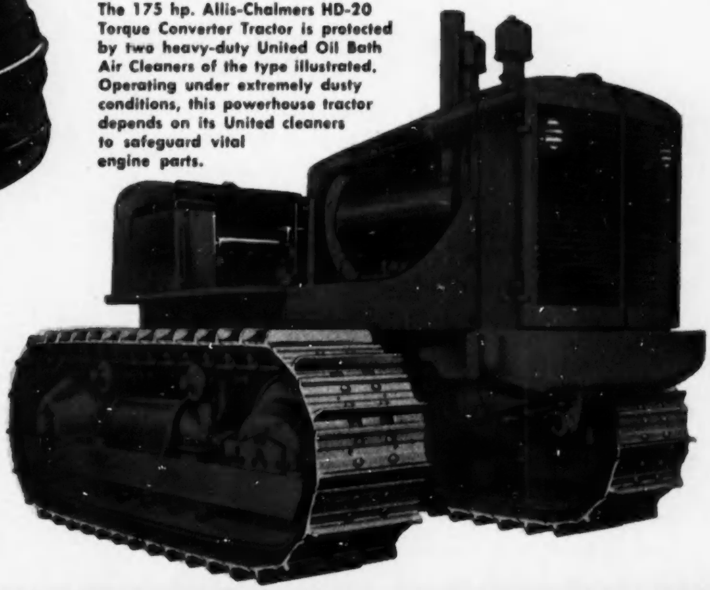


This new United Oil Bath Air Cleaner which protects the Allis-Chalmers HD-20 engine provides a three-point safeguard against dust and other engine abrasives. The first is the pre-cleaner which removes a major portion of airborne dust before it reaches the air cleaner. The second and third are in the newly designed oil bath element of the air cleaner. Here two separate, removable filter elements have replaced the single, fixed cleaning element. These dust-trapping units are easily removable for thorough cleaning and servicing, thus assuring operation of cleaner at top efficiency at all times.

Under test conditions far more severe than are encountered during average working conditions, this new United Oil Bath Air Cleaner removed over 98.6 percent of harmful dust and abrasives from air entering engine.

United air cleaner engineers working closely with customers' technicians are constantly providing new, improved air cleaner designs for a wide variety of internal combustion engines.

The 175 hp. Allis-Chalmers HD-20 Torque Converter Tractor is protected by two heavy-duty United Oil Bath Air Cleaners of the type illustrated. Operating under extremely dusty conditions, this powerhouse tractor depends on its United cleaners to safeguard vital engine parts.



Exploded view showing new air cleaner with removable filter elements. These easily removable discs can be taken out, serviced and replaced with a minimum of effort and time.

UNITED SPECIALTIES COMPANY

United Air Cleaner Division — Chicago 28
Mitchell Division — Philadelphia 36
Birmingham 11, Alabama

AIR CLEANERS • METAL STAMPINGS • ROLLED SHAPES
IGNITION AND TURN SIGNAL SWITCHES • DOVETAILS

YOU'LL NEVER CATCH

a deer napping

The wooded glen his home, the graceful leap his stock in trade . . . this fellow is always alert, a step ahead. With a long suit in intelligence, he knows just when to go—where to go. Once decided he's up and away, fleet afoot and fast.

Looking before you leap into the manufacture of a new product is very important. Chances are, by allowing yourself the time to *plan ahead* you will *be ahead* in the long run. Early investigation of castings offers you many benefits, especially when you consult Campbell, Wyant and Cannon. Experts in metallurgical engineering, precision control, mechanization of production, CWC provides you with castings that allow greater design freedom, wear longer, machine easier—all at much less cost.

Why not let CWC experienced engineers help you draw a bead on a better product? It might mean you'd have time to head for the woods and match wits with the wary deer.

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Since 1908

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—backbone of the internal combustion engine.

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Other Plants: BATTLE CREEK AND JACKSON, MICHIGAN


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CLARK EQUIPMENT COMPANY
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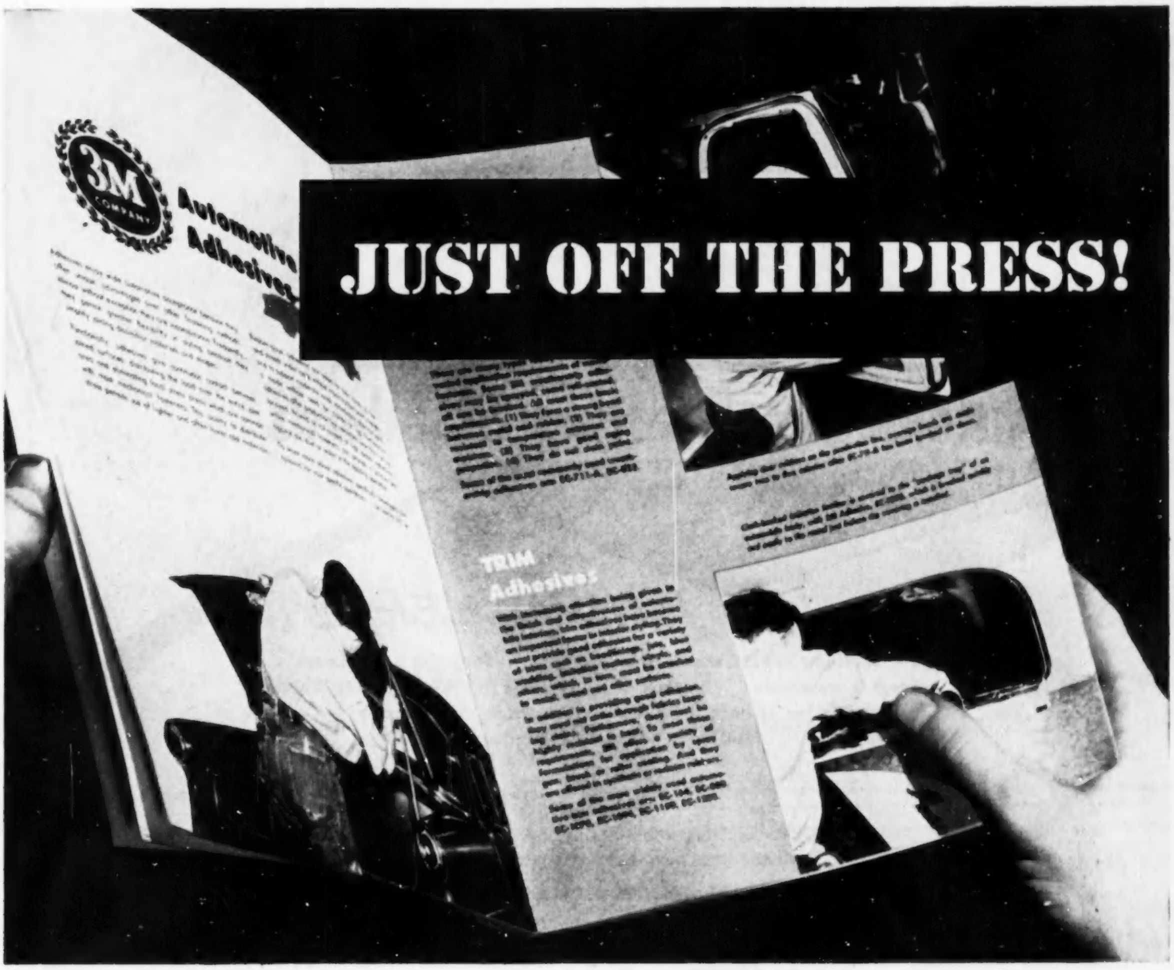
Other Plants: Battle Creek and Jackson, Michigan



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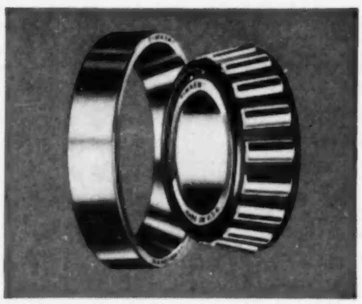

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